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ENVIRONMENT

Mitch Cron
USEPA Region III
Hazardous Site Cleanup Division (3HS22)
1650 Arch Street
Philadelphia, PA 19103

Subject:
Bally Groundwater Contamination Superfund Site
Finalized Focused Feasibility Study Submission

Date:
12 February 2007

Contact:
Michael Bedard

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Our ref:
NP000597.0002.00014

Dear Mr. Cron:

On behalf of Sunbeam Products, Inc. (Sunbeam), ARCADIS U.S., Inc. (ARCADIS) is submitting the requested two hard copies and one PDF of the final Bally Groundwater Focused Feasibility Study (FFS). Should you require additional copies, please do not hesitate to contact Sunbeam or ARCADIS.

Sincerely,

ARCADIS U.S., Inc.

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Focused Feasibility Study

Bally Groundwater Contamination Site
Municipal Water Supply

29 September 2006

Revised February 2007

ARCADIS

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Focused Feasibility Study

Bally Groundwater Contamination Site, Municipal Water Supply

Prepared for:

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Prepared by:

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Date:

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Executive Summary

In February 2003, 1,4-dioxane was detected in groundwater provided to the Bally public water system by Municipal Well Number 3. The concentrations of 1,4-dioxane detected were approximately 30-45 micrograms per liter. As a result, in September 2003, the United States EPA and Sunbeam Products, Inc. (Sunbeam) entered into an Emergency Administrative Order on Consent pursuant to the Safe Drinking Water Act (AOC) requiring that Sunbeam monitor the 1,4-dioxane levels and prepare a Focused Feasibility Study (FFS) to consider two potential remedies: 1) treatment of the water presently produced by Municipal Well Number 3 to remove the 1,4-dioxane to a level less than 3 micrograms per liter, or another concentration approved by the United States EPA if 3 micrograms per liter is not practical and achievable on a consistent basis; and, 2) replacement of the Bally Municipal Well Number 3. This document was prepared to comply with the FFS requirements of the AOC.

ARCADIS G&M Inc., at the request of Sunbeam investigated both the treatment and well replacement options. The treatment portion of this evaluation focused on advance oxidation processes (AOPs).

The screening of technologies indicated that only two processes were viable for further evaluation. The processes retained for further evaluation were gaseous ozone (ozonation) and ultra-violet light/hydrogen peroxide (UV/peroxide) treatment. These two processes were further evaluated through bench scale testing conducted by Trojan Technologies Incorporated and the Michigan State University.

The bench scale testing indicated that further testing of these treatment technologies would be required prior to implementation because byproducts such as bromate and formaldehyde were observed in the test system effluent during the bench scale testing. Furthermore, the bench scale testing indicated that treatment is not presently a viable alternative because of the potential for byproduct formation.

Sunbeam explored various locations for possible installation of a new municipal drinking water well. Well PW-01, located north of the borough was identified as a potential new source for Bally. Aquifer testing conducted at this location indicated that this well produces a sufficient quantity of water meeting the Pennsylvania Department of Environmental Protection requirements for a community water supply source.

This Focused Feasibility Study recommends the replacement of Municipal Well Number 3 with a new municipal supply well. In this case well PW-01, installed and tested in 2005 and 2006, would be the recommended replacement well. It is therefore recommended that Alternative 2 (Replacing Municipal Well Number 3 with well PW-01) be selected as the alternative to address the 1,4-dioxane in groundwater at the Bally Groundwater Contamination Superfund Site.

1. Introduction and Site Characterization

1.1 Introduction

The Bally Groundwater Contamination Superfund Site (Site) is located in eastern Berks County, Pennsylvania at the southern end of the Borough of Bally (Bally). Figure 1 shows the location of Bally. Groundwater contamination at the Site consists of volatile organic compounds (VOCs) discovered in approximately 1981, and 1,4-dioxane, discovered in 2003 during a special sampling event. The remedial strategy for addressing VOCs in groundwater was described in the 1989 Record of Decision (ROD) and 1990 Explanation of Significant Differences (ESD) for the Site. Groundwater is presently extracted from Municipal Well Number 3 (MUN-3) within Bally treated to remove VOCs and used to supply water to the Bally municipal water system. The present MUN-3 treatment system does not remove the 1,4-dioxane that is present in the groundwater.

An Emergency Administrative Order on Consent (AOC) was executed in September 2003 by the United States Environmental Agency (USEPA) and Sunbeam Products, Inc. (Sunbeam). The AOC presented a proposed target low level drinking water (target) for 1,4-dioxane at the Site of 3 micrograms per liter (μg/L), although a higher value could be calculated in consultation with the USEPA and PADEP if 3 μg/L was not feasible to achieve. Additionally the AOC required that a Focused Feasibility Study (FFS) be conducted to determine an appropriate remedial alternative for establishing a public water supply for Bally. Pursuant to the AOC, this FFS has been conducted to evaluate a focused subset of remedial alternatives that have been previously screened and present the most viable options. The purpose of the FFS is to facilitate selection of a remedial alternative that is protective of human health and the environment.

This FFS has been conducted in accordance with the FFS Work Plan for the Site (ARCADIS, 2004), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the USEPA's Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (USEPA, 1989), and the National Oil and Hazardous Substances Contingency Plan (NCP).

1.1.1 Objectives of Report

The objectives of this FFS include the following:

- Summarize Site geologic/hydrogeologic environment and history;

- Identification of remedial action objectives (RAOs);
- Development of potentially applicable or relevant and appropriate requirements (ARARs) and to-be-considered (TBCs) standards and guidance;
- Discussion of potential remedial alternatives;
- Comparative evaluation of remedial alternatives; and
- Selection of recommended remedial alternative for groundwater.

1.1.2 Report Organization

This report is organized into the following sections:

1 Introduction and Site Characterization

2 Identification of Remedial Action Objectives and ARARs/TBCs

3 Remedial Technologies, Technology Screening and Development of Remedial Alternatives

4 Detailed Analysis of Alternatives

5 Recommended Alternative

6 References

1.2 Site Characterization

The following sections summarize the geologic and hydrogeologic environment in which the Site is located and the results of historic investigative and remedial work conducted at the Site.

1.2.1 Site Geologic and Hydrogeologic Setting

Bally is located at the northwestern edge of the Piedmont Physiographic Province, an area characterized by rolling hills and meandering streams. Figure 2 shows the Site Geological Base map. To the northwest of the Site lie steep hills of the Reading Prong section of the New England Physiographic Province. The two provinces are divided by a northeast-southwest trending fault zone that creates a zone of increased groundwater permeability, storage and recharge (ARCADIS, 2006).

Bedrock in the area to the northwest of the fault zone is composed of resilient and low permeability granitic gneiss which forms the core of the Reading hills. Within the fault zone a wedge of dolostone and (reportedly) quartzite is present. The high permeability dolostone in conjunction with the physically rendered secondary porosity created by stress and movement in the fault zone create a prolific water-bearing zone. This zone recharges the thick alluvial deposits of the Brunswick Formation that compose the Piedmont Physiographic Province (Ibid).

The Brunswick Formation is composed of shale, siltstone and sandstone with interspersed zones of fanglomerate, which are high permeability alluvial deposits composed of angular dolostone, quartzite and gneissic clasts in a red shale-sandy-siltstone matrix. The fanglomerate is only present near the edge of the Newark Basin where the fault zone and the associated sharp topographic divide provide the necessary elevation and source material.

Similar to many other small towns and villages that dot the fault zone, Bally was sited based upon its proximity to springs that emerge from the hillsides of the Reading Prong. Bally has historically derived its water supply from these springs and from wells completed in the prolific aquifer created by the fault zone and adjacent fanglomerate deposits. Extensive investigations (ARCADIS, 2006; CEC, 1994; CEC, 1996; CEC, 2002; REMCOR 1989) have been conducted to characterize the aquifer.

1.2.2 Site History

Manufacturing activities at what was previously the Bally Engineered Systems (BES) plant began in the 1930s with the production of high-quality cabinets and cedar chests by the Bally Case and Cooler Company (BCC). Production facilities were briefly commissioned in the 1940s by the government to assist in the war effort. In the 1950s the main product line became continuous line, porcelain coated meat display cases and porcelain panels for use in constructing building facades. In 1984 BCC was renamed Bally Engineered Structures, Inc. (BES).

Use of degreasing solvents at the plant occurred in two principal areas. A 2,000-gallon capacity degreasing tank was formerly located in what became the BES carpentry shop. This tank was used from the late 1950s until approximately 1969 to degrease the shells of the meat display cases prior to the application of a urethane insulating material. The cases were dipped in the tank and staged nearby to dry prior to applying the insulation. Trichlorethylene (TCE) was the only solvent known to be used in this tank.

The second area was a 600 gallon degreasing tank for cleaning small parts used to fabricate an interlocking mechanism for the insulated panels. This tank was in use from the early 1960s until the mid 1980's. 1,1,1-Trichloroethane (TCA) was used in this small parts degreasing tank. In addition, solvents were reportedly used as flushing agents to clean case molds and urethane foam injection nozzles in the plant foaming department from the mid-1960s to the mid-1980's.

The principal chlorinated VOCs found in the aquifer are TCA, TCE and 1,1-dichloroethene (DCE). Use of TCE was suspended in about 1969 along with the cessation of production of the meat display cases. TCA was used in the small parts degreasing tank from 1980 until 1986, when it was replaced by a nonchlorinated solvent. None of the principal chlorinated VOCs found in the aquifer were used as flushing agents in the foaming department after 1986. Spent degreasing solvents were managed as a Resource Conservation and Recovery Act (RCRA) hazardous waste at the Site after hazardous waste regulation began in 1980 (EPA, 1989). Flushing agents used in the foaming department were recycled and reused.

A review of archival aerial photographs suggested that four shallow lagoons existed at the facility (EPIC, Undated). Two lagoons were present from approximately 1955 until they were relocated to the south to facilitate plant expansion and the two southern locations were constructed. The second pair remained until approximately 1970 when they were backfilled to facilitate the construction of the present office building located to the south of the second lagoon location. As part of the Remedial Investigation (RI) both the lagoon sites and the areas of degreasing solvent use in the plant were examined in an effort to identify a contamination source area at the Site (USEPA, 1989).

Samples collected in 1982 from MUN-3 exhibited elevated levels of VOCs. Consequently, use of MUN-3 as a public water supply ceased, and the town reactivated Municipal Well No. 1 (MUN-1). MUN-1, in conjunction with a group of springs to the northwest of Bally, were formerly used to supply water to the municipal system during the period between 1959 and 1979, prior to installation and permitting of MUN-3. In addition to the municipal wells, two industrial wells were actively used within Bally and several residential wells operated down gradient of the Site. The residential wells have all since been abandoned and the industrial wells are used only for industrial process uses (USEPA, 1989).

BES signed a consent order in January 1987 with EPA to conduct the remedial investigation and feasibility study (RI/FS) at the Site. The purpose of the RI/FS was to determine the source and extent of volatile organic compound (VOC) impacts within the aquifer, assess public health and environmental receptor concerns, and define remedial action objectives and remediation levels specific to the Site groundwater contamination. A Phase III RI was conducted by Remcor and the report was issued in May1989 (USEPA, 1989). The RI identified six possible compounds of concern (COC)s for the Site. These six possible COCs are tetrachloroethylene (PCE), TCE, DCE, TCA, 1,1-dichloroethane (DCA) and methylene chloride. The investigation concluded that all of these compounds with the exception of DCA were present at concentrations sufficient to warrant their inclusion in the final list of COCs.

Investigation to delineate the extent of the groundwater contaminated zone indicated that the COCs were mostly present between the former BES facility and MUN-3 with the greatest concentrations near in the vicinity of the northern edge of the facility (between the 86-3 well cluster and the 86-4 well cluster (Figure 3). Data derived from the RI and subsequent investigations indicate that when MUN-3 operates it effectively captures and controls the migration of COCs from the former BES facility (Figure 4). During the period from 1979 to 1982 before the discovery of contamination in MUN-3 the two wells operated intermittently. Then during the period from 1982 to early 1987 MUN-3 was pumped intermittently (but not used for potable water) as a means of plume control while MUN-1 was operated to supply water to Bally. This was followed by a period of more than two years during which MUN-3 was completely inactive and MUN-1 was used exclusively. As a result during this period the dissolved phase groundwater plume expanded towards MUN-1. Following the two year period of inactivity, once the NPDES permit was renewed, MUN-3 was reactivated as a means of plume control (Remcor, 1989).

The RI identified that the primary complete exposure pathway was through untreated groundwater entering the Bally municipal potable water supply and through one hand-pumped private well within Bally. Therefore, in parallel with the preparation of the RI report, a treatment system for MUN-3 was designed and installed.

Based upon the RI report and a draft Feasibility Study (FS) also issued in May 1989 (USEPA, 1989) the USEPA issued a Record of Decision (ROD) identifying groundwater extraction and treatment (pump and treat) through air stripping to remove Site related VOCs from the Bally groundwater and drinking water supply as the selected remedial alternative for the site. The cleanup goals for VOCs at the Site were established by the ROD (Appendix A). This remedy remains in place and continues to actively reduce the extent and concentration of the COCs in the groundwater plume; removing approximately 1,000 pounds of VOC's from the aquifer per year.

Peak Total VOC (TVOC) concentrations observed in the plume were just under 12,000 μg/L in 1989. During the late 1980's the plume extended to MUN-1 and the Great American Knitting Mill (GAKM) located at the foot of Church Street. TVOC concentrations at the 86-4 well cluster were in excess of 3,500 μg/L and concentrations at MUN-1 were approximately 107 μg/L. By 1995 the TVOC concentration at MUN-1 had decreased to 5.2 μg/L and concentrations between MUN-3 and MUN-1 had decreased from hundreds of μg/L to tens of μg/L (Figure 3). The remedial progress can be summarized by the following established contaminant reductions at several key locations:

- Concentrations in the vicinity of the suspected source area have decreased.
- TVOC concentrations in 87-4I have decreased two orders of magnitude from just under 4,000 μg/ L to 36 μg/L.
- TVOC concentrations in 86-3D have decreased by one order of magnitude from just under 1,700 μg/ L to 158 μg/ L.
- Concentrations in the remediation well MUN-3 have decreased by 80 percent from just under 12,000 μg/L (Remcor May 1989) to 2,500 μg/L.
- Concentrations at the former northernmost extent of the plume, MUN-1 have decreased by two orders of magnitude from 107 μg/L to less than the laboratory detection limit. The northern extent of the plume is presently south of the 87-7 well cluster.
- Concentrations in the Southern Area (well 92-17), where a second recovery well had been proposed, have decreased by two orders of magnitude, from greater than 600 μg/L TVOC to 4.3 μg/L.

The points listed above indicate that the originally identified remedy has been successful in controlling the plume and reducing the extent and concentrations of VOCs in groundwater.

1.2.2.1 Summary of air stripper process operations

The remedy identified in the 1989 ROD selected a physical removal process, air stripping, as the best available technology for removing the VOCs from the Bally municipal water supply. Air stripping removes VOCs from water by cascading the water down a tower filled with a complex array of surfaces designed to maximize the surface area of the water as it flows from the top to the bottom of the tower. A constant flow of air is forced upwards through the tower over the water surfaces, causing the VOCs to volatize out of the aqueous state, leaving the water free of the VOCs. Effluent from the system is discharged to an unnamed tributary of the West Branch Perkiomen Creek (West Branch) when MUN-3 is not providing water to the Bally municipal public water system. The treatment system is sampled weekly to ensure that the liquid effluent of the system remains in compliance with the PADEP National Pollutant Discharge Elimination System (NPDES) permit for the system. Additionally, water samples are collected to monitor the air emissions of the treatment system to ensure that concentrations remain within PADEP requirements.

1.2.3 Discovery of 1,4-dioxane in Groundwater

Around 2001 chlorinated solvents were identified in groundwater at a number of industrial and commercial facilities and continuing investigations associated with these facilities, concern arose with regard to solvent stabilizers at such sites. Investigations to evaluate the potential presence of solvent stabilizers were conducted at a number of sites beginning in California in the late 1990s.

In early 2003, in response to the emergence of 1,4-dioxane as a potential COC, a series of special sampling events were conducted at the Site. In February 2003, evaluation samples were collected from MUN-3, Site monitoring wells and a selected set of private monitoring wells. 1,4-Dioxane was detected by the laboratory in MUN-3, and was estimated by the laboratory to be present in one other well below the laboratory reporting limit but above the method detection limit. This was followed by collection of samples at MUN-3 and MUN-1 in early March 2003. Samples were collected from both of these wells and submitted for analysis. While 1,4-dioxane was not detected in MUN-1, it was detected in MUN-3 at a concentration of 30 μg/L. Consequently, in March 2003 a special comprehensive low-flow groundwater sampling event was conducted to evaluate the extent of 1,4-dioxane in groundwater through sampling of Site monitoring wells (ARCADIS, June 2003). As described in the ARCADIS report for this sampling event, the analytical results of this sampling event indicated that 1,4-dioxane was present in four of the twenty-eight wells sampled during this event. All four of these wells were located within 300 feet of the former BES facility. Therefore, MUN-3, located less than 700 feet from the facility, is the furthest well with a detection of 1,4-dioxane above the laboratory reporting limit. The distribution of 1, 4-dioxane as indicated by the results of this sampling event combined with date from MUN-1 and MUN-3 indicate that 1,4-dioxane in groundwater is confined to the area between MUN-3 and the former BES facility (Figure 3).

1.2.3.1 Site Activities Due to 1,4-dioxane

In response to the confirmation of 1,4-dioxane in the Bally water supply system USEPA issued an Emergency Administrative Order on Consent (AOC) to Sunbeam dated September 30, 2003. The decree identified a maximum target drinking water groundwater concentration for 1,4-dioxane of 3 μg/L, unless this concentration was not technically feasible. Under those circumstances, a different target concentration could be developed in conjunction with USEPA and PADEP. Additionally the AOC directed Sunbeam to evaluate installing a replacement water supply well as an additional treatment option for groundwater produced by MUN-3. Given the chemical and physical properties of 1,4-dioxane, removal of the compound through air stripping treatment is ineffective.

Because 1,4-dioxane emerged as a new contaminant early in the in the late 1990's and was not identified at the Site until early 2003, relatively little Site data is available for this compound. The following paragraphs provide a discussion of the existing 1,4-dioxane data for the Site.

Beginning in February 2003, and continuing through present, groundwater samples have been collected on at least monthly (and in some cases weekly) intervals from MUN- 3 and analyzed for 1,4-dioxane and VOCs. Presently, groundwater samples are collected from MUN-3 on a weekly basis following air stripping treatment and analyzed for 1,4-dioxane.

Groundwater samples from MUN-3 were analyzed for 1,4-dioxane by Severn Trent Laboratories, Inc. (STL) for the period from February 19, 2003 through January 6, 2005, and by Analytical Laboratory Services, Inc. (ALS) for the February 5 and 12, 2003 events and from February 16, 2005 through the present. The change in analytical laboratories was required to meet an increased sampling frequency requirement mandated by the 2005 NPDES permit Table 1 provides the analytical results for 1,4-dioxane collected from the effluent at MUN-3. Figures 3 and 5 depict the groundwater concentration trends for 1,4-dioxane.

Analytical results for 1,4-dioxane indicated that concentrations of this constituent in effluent groundwater samples ranged from 24 µg/L to 77 µg/L these concentration exceed the proposed groundwater standard of 3 µg/L for this compound for this Site. However, they are below the NPDES permitted concentration of 112 µg/L. In consultation with PADEP, the NPDES permit for 1,4-dioxane discharged to the West Branch was determined to be 112 µg/L. Details on this permit are discussed in greater detail in Section 4.2.

1.2.4 Risk Assessment

As described in the AOC, 3 µg/L was selected as a safe drinking water standard based on a 70-year exposure duration. Assuming a 30-year exposure duration increases the standard to 6 µg/L. Both these values were calculated based on toxicity information available in USEPA's Integrated Risk Information System (IRIS) database. Currently, IRIS lists a cancer slope factor (CSF) for 1,4-dioxane of $1.1x10^{-2}$. However, as noted in the FFS work plan, USEPA is actively revising the 1,4-dioxane CSF. The projected date for the next publicly available draft of assessment is November, 2007. Preliminary information, however, indicates that the CSF may change by up to three orders of magnitude. Under these conditions, the drinking water standard could also increase by three orders of magnitude and still provide protection of human health at a 1×10^{-6} risk level.

These findings are consistent with previous risk assessments conducted by ARCADIS for other sites with 1,4-dioxane in groundwater (ARCADIS 2005c). Using the current 1,4-dioxane CSF, a Risk Based Clean-up goal (RBC) of 6 µg/L was calculated assuming a 30-year exposure to drinking water at a risk level of 1×10^{-6}. However, because of the likelihood that the IRIS toxicity values for 1,4-dioxane, which have a direct effect on establishing remediation goals for remedial actions, will be updated by USEPA within the next 12 to 18 months, RBCs for 1,4-dioxane for a range of CSFs can be calculated for the purpose of comparing remedial alternatives for groundwater (ARCADIS, 2005). Assuming that the CSF decreased by one or two orders of magnitude results in RBCs of approximately 60 µg/L and 670 µg/L, respectively, at a 1×10^{-6} risk level. Based upon this information concentrations of 6 µg/L to 670 µg/L are expected to be protective of human health at a risk level of $1x10^{-6}$.

1.2.5 Ecological Risk of 1,4-dioxane

Since groundwater effluent from MUN-3 will be discharged to the West Branch, it is also important to consider potential ecological effects. Overall the data indicate that the range of 1,4-dioxane concentrations typically observed in the effluent (< 70 μg/L) is well below the level of concern for ecological receptors. Previous studies on fathead minnows and other aquatic organisms did not identify adverse effects at concentrations below 6,000 μg/L (SCWD, 2001). The Michigan Department of Environmental Quality (DEQ) has calculated a Final Acute Value (FAV), an Aquatic Maximum Value (AMV), and a Final Chronic Value (FCV) for 1,4-dioxane of 390, 200, and 22 μg/L, respectively. The FCV represents the concentration fish and other aquatic organisms can be continuously exposed to without experiencing any mortality, developmental or reproductive effects. The AMV is the highest concentration to which an aquatic community can be exposed briefly without resulting in unacceptable effects. Effluent concentrations are well below the AMV, but may be slightly above the FCV immediately upon discharge. However, once released into the receiving stream, concentrations of 1,4-dioxane will be immediately diluted to concentrations below the FCV.

Finally, the lack of ecotoxicity from effluent is supported by direct toxicity studies. A report describing acute and chronic toxicity of undiluted effluent from the existing MUN-3 treatment system reported no observable effect on survival or reproduction of Ceriodaphnia dubia or fathead minnows in 100 percent (%) system effluent and serial dilutions of 6.25%, 12.5%, 25% and 50% (CEC, 1994). A calculated Log Bioconcentration Factor was determined to be -0.44. 1,4-Dioxane is not expected to bioconcentrate in fish and other aquatic organisms (Hansch et al, 1985; Howard 1990). As a result, ecological risks are not expected for wildlife feeding on fish and other aquatic organisms exposed to 1,4-dioxane in the treatment system effluent. Under these conditions, toxicity testing or biological community surveys are unnecessary.

1.2.6 Nature and Extent of Contamination

VOC contamination in the Aquifer has been previously delineated as part of the Phase II and Phase III remedial investigations (ERM, 1986; REMCOR, 1989). The extent of 1,4-dioxane contamination was delineated by ARCADIS during the March 2003 Comprehensive Groundwater Sampling event. As shown on Figure 3, the extent of 1,4-dioxane is limited to the area between the former Facility and MUN-3. Additionally the vertical extent of 1,4-dioxane is largely confined to the shallow and intermediate zones with the only Wells 86-3D and MUN-3 exceeding the 3 μg/L criterion.

1.2.7 Fate and Transport

The 1,4-dioxane in the aquifer is limited to the area between the facility and MUN-3. From Figure 3 it is apparent that the highest concentrations of 1,4-dioxane are stretched between the former facility and MUN-3 indicating that transport of 1,4-dioxane is occurring from the former facility to MUN-3 along with the VOCs. Therefore the fate of the 1,4-dioxane in the aquifer is captured through MUN-3.

1,4-Dioxane that is discharged to the unnamed tributary of the West Branch under the present treatment/discharge configuration is attenuated through processes that include photodegradation and dilution. 1,4-Dioxane that may be discharged directly to the West Branch under a future discharge scenario also would be subject to photodegradation, and a much higher degree of dilution due to the relatively high flow rate of the West Branch as compared to the unnamed tributary.

2. Identification of Remedial Action Objectives and ARARs/TBCs

The object of this FFS is to present a description of the problem, identify the relevant legal standards and evaluate other potentially applicable criteria. The sub-sections below identify and describe these items.

2.1 Remedial Action Objectives

Remedial Action Objectives (RAOs) are based upon media specific and general requirements to protect human health and the environment. At the Site the primary exposure pathway is consumption of and dermal exposure to water containing 1,4-dioxane. Therefore, the RAOs for the Site are to discontinue the possible exposure of Bally residents to water containing 1,4-dioxane above the Applicable and Relevant Criteria (ARARs) or To Be Considered (TBC) criteria that have been identified in this report. Furthermore the remedy must continue to provide control of the plume presently undergoing remediation.

2.2 Identification of Applicable Relevant and Appropriate Requirements and To Be Considered Criteria

This section provides an overview of potential ARARs and TBCs, at the federal state, and local levels, which will be used to evaluate remedial alternatives. Table 7 presents the ARARs. Applicable requirements are those clean-up standards, standards of control, or other substantive environmental protection requirements, criteria or limitations promulgated under federal or state law which specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. Relevant and appropriate requirements are those federal state, and local requirements which, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site and its constituents. TBC standards and guidance are non-promulgated advisories or guidance issued by federal, state, or local agencies that, although not legally binding, can be used in determining the level of clean-up for protection of health or the environment (USEPA, 1988). The 3 μg/L criterion for 1,4-dioxane would therefore fall into the last category.

Further classification of requirements has been developed to provide guidance on identification and compliance with ARARs and TBCs. The three classes include chemical-specific, action-specific, and location-specific.

- Chemical-specific requirements are usually-health or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

- Action-specific requirements are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

- Location-specific requirements are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they occur in special locations. Examples of these special locations include floodplains, wetlands, coastal areas, historic places, and sensitive ecosystems or habitats (USEPA, 1988a).

The COCs in groundwater at the BES site include VOCs and 1,4-dioxane. Chemical-specific ARARs for the VOCs were defined in the ROD based on maximum contaminant levels (MCLs) and water supply permit requirements established by PADEP (USEPA, 1989). Appendix A provides the previously established ARARs for VOCs at the site. As 1,4-dioxane is the only constituent of concern for which ARARs or TBCs have not been established previously for the Site the following paragraphs are limited to the potential requirements for 1,4-dioxane.

Applicable chemical-specific drinking water requirements are not available for 1,4-dioxane for the Bally Site as no MCL has been established by USEPA or PADEP for this compound. A chemical-specific TBC for 1,4-dioxane was developed for the Site as part of the Emergency AOC between USEPA and Sunbeam. The AOC established that any new municipal supply well option or groundwater treatment option for the Borough of Bally should achieve a reduction of the 1,4-dioxane concentration in the Bally PWS to 3 μg/L or, if not practical, feasible and reasonably achievable on a consistent basis, some other concentration approved by USEPA. Therefore, this TBC, while not promulgated under federal or state law, is an applicable chemical-specific requirement for drinking water at the Bally Site and may be considered the governing requirement for 1,4-dioxane concentrations in drinking water.

In addition, PADEP has approved a NPDES permit for discharge of groundwater treatment system effluent containing average monthly concentrations of 1,4-dioxane of 112 μg/L to an approved location along the West Branch. Therefore, the NPDES permit establishes an applicable action-specific ARAR of 112 μg/L for the average monthly discharge concentration and 224 μg/L for the maximum monthly discharge concentration. Preparation of the NPDES permit concentrations includes evaluation of human health effects as well as effects on stream life. Therefore, this 1,4-dioxane concentration is protective of both human and ecological receptors.

PADEP Wetland and Water Encroachment permits have been issued for construction associated with the discharge pipeline. These permits are considered location-specific ARARs. Phase I bog turtle surveys were also conducted for both the proposed discharge pipeline route from MUN-3 and for the Longacre property and associated water pipeline route to Bally Borough. A follow-up Phase II survey was also conducted at the Longacre property. As part of the ongoing work for this project, ARCADIS, on behalf of Sunbeam, is in the process of confirming that the U.S. Fish and Wildlife Service and the Pennsylvania Fish and Boat Commission still concur with the results of the prior bog turtle surveys. Copies of the Phase I survey report for the discharge pipeline, the Phase II survey report for the Longacre property and the initial concurrence letters are provided in Appendix B.

Also, erosion and sediment pollution control plan approvals by the Berks County Conservation District (BCCD) are considered ARARs for these construction projects, and the BCCD has approved the erosion and sediment pollution control plan for the discharge pipeline project.

In addition to these Site-specific TBCs, additional TBCs can be found in health advisory guidance criteria published by USEPA and environmental agencies of other states. Superfund sites where 1,4-dioxane is an issue in several other states were reviewed. However, because USEPA's review of 1,4-dioxane has not been completed, other available criteria regarding 1,4-dioxane were considered. These criteria include the following:

- The initially identified notification level for 1,4-dioxane in California is 3 μg/L (CDHS, 1998). However the response level (the level at which a source should be taken out of service) is 100 times the notification level or 300 μg/L (CDHS, 2006).

- The EPA presently has an immediate action level of 600 μg/L (for 1,4-dioxane). This indicates that in the event that concentrations of 1,4-dioxane greater than 600 μg/L were encountered EPA would take immediate action to address the issue (USEPA, 2004b).

- USEPA Region I and the Connecticut Department of Health have issued an interim drinking water comparison level of 20 μg/L at the Durham Meadows Superfund Site, designed to be protective of the potential cancer and non-cancer effects of 1,4-dioxane (USEPA, 2004a). This concentration updates the previously used 1,4-dioxane RBC of 6.1 μg/L based upon the same IRIS data that was used to generate the 3 μg/L criteria set by the Site AOC.

- USEPA Region II, U.S. Department of Health and the New York State Department of Health have applied the New York State public drinking water standard of 50 μg/L as the appropriate risk level for 1,4-dioxane in drinking water at the Mohonk Industrial Plant Site (USDOH, 2005).

- The MDEQ has revised its generic residential drinking water standard for 1,4-dioxane upward from 3 μg/L to 77 μg/L and then 85 μg/L (SCWD, 2001; MDEQ, 2005). Additionally the acceptable surface water concentration for Michigan is 2,800 μg/L.

Additionally because USEPA required that the installation of a new well be considered as one of the FFS alternatives, requirements and criteria of the Delaware River Basin Commission (DRBC), which controls water supply allocations within the Delaware River Basin, were considered. Bally is located at the edge of this basin in an area of lesser concern to the DRBC. However, Bally will be required to justify its water allocation request to the DRBC before being granted an allocation.

3. Remedial Technologies, Technology Screening and Development of Remedial Alternatives

Pursuant to the guidance for FS preparation (USEPA, 1990) this section describes the identification of remedial technologies, the screening of those technologies and the development of remedial alternatives using the identified technologies.

3.1 Identification and Screening of Remedial Technologies

In accordance with the requirements of the AOC, two general approaches were reviewed: 1) replacement of the existing drinking water supply source and 2) treatment of the existing drinking water supply to achieve a reduction of the 1,4-dioxane concentrations in the Bally PWS to 3 μg/L or, if not practical and feasibly and reasonably achievable on a consistent basis, some other concentration approved by USEPA.

Remedial technologies are not applicable for the installation of a new municipal supply well, as this activity is not expected to increase treatment of extracted water beyond the chlorination that is typically conducted for water supply systems. Therefore the remedial technologies described in this section are discussed in terms of treatment of water extracted from MUN-3 for use in the Bally municipal water supply system.

The chemical characteristics of 1,4-dioxane limit the available treatment technologies for the purpose of supplying drinking water to the Bally water supply system. Table 3 provides the results of the initial technology screening conducted by ARCADIS. For the purposes of this document, as stated in the FFS Work Plan, only Advanced Oxidation Processes (AOP) will be considered as a treatment method.

3.1.1 Ozone-Catalyzed Hydrogen Peroxide (O_3/H_2O_2) Oxidation

Ozone-catalyzed hydrogen peroxide oxidation utilizes ozone (O_3) and hydrogen peroxide (H_2O_2) for the degradation of organics in water. H_2O_2 is typically mixed into the influent treatment stream prior to entering a baffled O_3 reactor. Upon contact with H_2O_2, sparged O_3 in the reactor catalyzes the production of hydroxyl radicals ($^{\bullet}OH$) for the oxidation process. Hydroxyl radical available for oxidation can be tailored to the contaminant concentration by adjusting the influent O_3/H_2O_2 concentrations. After sufficient contact time, water from the reactor is collected for disposal. Unit processes involved in this remedial approach include an O_3 generator, the reaction vessel, and a catalytic O_3 decomposer to scavenge unreacted dissolved O_3. Because of the additional logistics and the operational costs associated with this option, it was not effective in comparison with other available technologies.

3.1.2 Oxidation via Direct Ozonation

Oxidation via direct ozonation is similar to the oxidation process discussed above in that O_3 is sparged into a reaction vessel for the oxidation of dissolved organic contaminants. The absence of a catalyst [e.g. Ultra Violet (UV) radiation, H_2O_2] in this process, however, increases the necessary retention time for complete degradation. Due to the long reaction times as well as the high costs associated with O_3 treatment apparatus, this alternative was not retained for further analysis.

3.1.3 Titanium Dioxide (TiO_2) Photocatalytic Oxidation

Titanium dioxide photocatalytic oxidation typically utilizes flow-through photocatalytic reactor cells which are each surrounded with a TiO_2/fiberglass mesh. A UV light source is located coaxially to the flow through cells, and contact with bound TiO_2generates available electrons at the mesh surface. Water passing across this interface will dissociate to form $^{\bullet}OH$ and superoxide ($O_2^{\bullet -}$). While this technology has been identified as being potentially cost effective, it was ruled out for use in a municipal water supply setting for the following reasons:

- This is a relatively new technology and standardized operation procedures have not been thoroughly established for a municipal setting.

- The catalyst media used in the treatment process must be recaptured, recycled, and then replaced following treatment.

3.1.4 UV/Hydrogen Peroxide Oxidation

Oxidation with UV radiation and H_2O_2 is a conventional approach for the removal of organic contaminants. Generally, treatment systems produce no sludge, spent waste, or air emissions that require additional handling or disposal. Similar to the technologies discussed above, the oxidation process occurs in a series of flow-through reaction cells each which is equipped with a UV light source. H_2O_2 is supplied to the influent treatment stream, and photolysis with UV radiation creates dissolved $^{\bullet}OH$. Typically, acid is also supplied to the influent stream to decrease pH during the oxidation process; pH is then neutralized in the effluent stream after treatment. Unit operations involved in this technology include an H_2O_2 supply unit, acid base supply vessels, and the UV oxidation flow-through units. Dissolved metals (iron, manganese) in the treatment stream may also become oxidized during this process, and periodic cleaning of the flow through cells may be necessary during operation and maintenance (O&M) activities to maintain treatment efficiency. This treatment strategy is commonly used for disinfection in municipal systems and is more cost effective than other available technologies. This approach was therefore selected for further consideration.

3.2 Development of Remedial Alternatives

Remedial technologies and process options retained during the preliminary technology evaluation and screening (Section 3.1) are assembled in this section into prescribed remedial actions and remedial action alternatives for the Bally water supply system. Each includes a description of the remedial action or alternative, including a conceptual design for implementation and a discussion of the assumptions made, which will provide a basis for detailed analysis and comparison to other alternatives. Section 4 presents a detailed and comparative analysis of the remedial actions and alternatives developed in this section.

3.2.1 Alternative 1: Installation of a New Groundwater Source

Alternative 1 will allow the delivery of a clean water supply via the installation of a new municipal well. As detailed in Section 4.2, characterization activities and pumping tests were conducted on the Bally aquifer to verify the feasibility of this alternative. Air stripping activities have been effective in treating the dissolved VOC plume and operation of the system in place at MUN-3 will continue. Additionally, this alternative will incorporate the installation of a new discharge pipeline to deliver the treatment system effluent to the West Branch. Long-term monitoring, as included in the current permit, will include monthly system sampling at MUN-3. In addition, long term monitoring of monitoring wells located in the vicinity of the Bally Site as well will be performed to verify the attenuation of the plume over time as well as verifying that pumping of the new well does not adversely impact the extent of the plume. In addition a series of contingency actions to address potential plume stability issues has been established with the input of EPA. The contingency plan is somewhat dynamic but includes actions such as increasing the pumping rate at MUN-3 and activation of cut off pumping at MUN-1. A final version of the plume monitoring program and contingency plan will be submitted to EPA for approval.

3.2.2 Alternative 2: Additional Treatment at MUN-3 Using Advanced Oxidation Processes

Alternative 2 involves the continued use of MUN-3 as the primary water supply well in Bally. Operation of the air stripping system will continue for VOC removal, but the existing system will be retrofitted with a UV/H_2O_2 treatment unit for the oxidation of 1,4-dioxane after passing through the air stripper. Discharge water from the air stripper will be mixed with H_2O_2 prior to entering the UV reactor. The necessary system flow rate, treatment unit sizing, and UV/ H_2O_2 dosing requirements will be finalized during the remedial design phase. Water discharged from the treatment system will be delivered as necessary to either the public water supply or the unnamed tributary outfall, as currently conducted. Long-term monitoring, as included under the existing permit, will include monthly system sampling at MUN-3. In addition, monitoring wells located in the vicinity of the Site as well will be monitored to verify the attenuation of the plume over time.

To be conservative, operation of the groundwater treatment system will be conducted for 30 years or until remedial goals have been achieved within the plume area. System and groundwater monitoring well sampling will also be conducted within this time frame.

4. Detailed Analysis of Alternatives

This section describes in detail each of the identified remedies to support the comparative analysis presented in Section 5.1

4.1 Remedial Alternative Screening Criteria

Per EPA guidance the following sections present each of the alternatives and evaluate the alternatives against the following nine criteria:

- Threshold Criteria – These provide the statutory requirements that the alternative must satisfy in order to be eligible for selection.
  - Overall protection of human health and the environment;
  - Compliance with ARARs;
- Balancing Criteria – These are the primary evaluation criteria on which the technical qualities of the alternatives are compared.
  - Long-term effectiveness and permanence;

- Reduction of toxicity, mobility or volume through treatment;
- Short-term effectiveness;
- Implementablity;
- Cost;

- Modifying Criteria – These are formally addressed during the public comment period.

  - State/ support agency acceptance; and,
  - Community acceptance.

The following sections present the comparison of each of these remedial options to the above criteria. A comparative analysis of the alternatives was performed based on these criteria. The results are presented in Section 5.1.

4.2 Bally Groundwater Treatment Alternatives Analysis

4.2.1 Alternative 1 – Installation of a New Groundwater Source

Alternative 1 includes the following required components: 1) a new municipal supply well; 2) continued air stripping treatment at MUN-3; and, 3) discharge of MUN-3 effluent to the West Branch. Figure 6 presents the major required components of this alternative.

4.2.1.1 Installation and Operation of New Municipal Supply Well

From 2003 through 2006, Sunbeam performed investigative work in cooperation with PADEP, USEPA, and Bally representatives to identify, test, and evaluate a suitable well site to provide a new municipal water supply well for Bally. Potential properties were initially identified based upon the fracture trace analyses performed by ARCADIS and the USEPA (EPIC, 1992). Ultimately the investigation was also driven by the ability to gain access to various properties. Access to one property has been achieved through an access agreement with the property owner and control of the required PADEP required Zone 1 Well Head Protection Area (WHPA) has been secured. A detailed investigation of the well site, including installation and testing of the proposed production well, PW-01, indicated that the well site will yield an acceptable quantity of drinking water to serve as a community water supply source for Bally. The results of the investigation were provided to PADEP and USEPA in the March 2006 Detailed Hydrogeologic Water Resources Investigation (WRI) (ARCADIS, 2006).

The proposed municipal supply well, PW-01, is located on a 2.5 acre parcel (Well Site) approximately 1,500 feet northeast of the northeastern Bally boundary, in an agricultural setting on a 40-acre privately-owned property (Property). Land use immediately surrounding the Property is residential and agricultural. PW-01 is supplied by an unimpacted aquifer region approximately 4,500 feet from the identified plume area that is pumped from MUN-3 to the southwest, and more than 3 miles from the Crossley Farm Superfund site located to the northeast well into the Reading Hills.

Groundwater flow in the region occurs largely in a southeasterly direction, approximately normal to the orientation of the Reading Prong. Flow moves from the relatively discrete fracture and recharge areas in the steep basins of the hills down through the Leithsville and Hardyston formations, and into deposits of the Newark Basin. The area where the investigation was conducted was predominantly within the limits of the Leithsville formation and centered on the wedge of dolostone located between the mapped locations of the Precambrian gneiss and the Newark Basin. Groundwater occurrence in the dolostone is variable as is typical of a karstic aquifer. Drilling data indicates that the Leithsville formation has features typical of karstic carbonate rock such as solution channels and significant secondary porosity.

Aquifer characterization included several tiers of testing culminating in an 8-day aquifer test conducted at 350 gallons per minute (gpm). Previous levels of testing included a 48-hour test and a 54-hour test. The 48-hour constant rate test conducted at 160 gpm was conducted in June 2005. The 54-hour constant rate (350 gpm) pumping test on PW-01 was conducted in October 2005 and established that PW-01 could support a discharge rate of 350 gpm for an extended period and that this was an appropriate rate for a final aquifer test. In December 2005, a final 8-day constant rate (350 gpm) pumping test developed in consultation with USEPA was conducted on PW-01 to meet the requirements for a new groundwater community water supply source set forth by PADEP and the Delaware River Basin Commission (DRBC).

The results of the aquifer testing program indicated PW-01 was completed in an exceptional fault aquifer system with above average groundwater storage and transmission potential as attested by a high specific capacity of PW-01 (2.6 gpm/ft), and in broader terms a relatively high aquifer transmissivity. In an average precipitation year, a 350 gpm withdrawal rate sustained for over a week is expected to result in approximately 220 feet of remaining available drawdown in the well and as much as 270 feet in the immediate surrounding aquifer and although the 8-day test identified that PW-01 interferes with MUN-3, this interference has no material effect on the yield of PW-01. Additionally the 90% or better recovery of the well in less than an hour further supports the capacity of the aquifer system. It should also be noted that the 8-day specific capacity of PW-01 was approximately twice that of MUN-3, suggesting that PW-01 is a much more efficient well than MUN-3. Additionally the proven sustainable production rate of PW-01 is approximately three times the 2026 projected water demand for Bally based upon the demand increase from the mid-1980s to present. Over that period Bally's average water demand increased from approximately 50 gpm to approximately 85 gpm. A linear increase over the next twenty years would indicate a 2026 water demand of approximately 136 gpm. Tripling the rate of growth would result in a 2026 water demand of approximately 238 gpm.

To evaluate the long term sustainability of the yield of PW-01 and to determine the magnitude of interference between PW-01 and MUN-3, late time drawdown from four key wells (including PW-01) was projected out to anticipate the effect of six months of pumping with no recharge. This analysis suggested that a total of approximately 110 to 120 feet of drawdown would occur at well PW-01 following six months of pumping with no recharge, leaving greater than 200 feet of available drawdown remaining. The projections indicate that the yield at PW-01 is sustainable and that a durable groundwater divide exists in the approximate vicinity of MUN-1. This divide will remain when wells PW-01 and MUN-3 are operated simultaneously (ARCADIS, 2006).

To assure that the long term operation of PW-01 does not promote adverse migration of the existing chlorinated VOC plume towards well PW-01, preventive measures have been defined to first allow assessment of any plume changes, and then secondly to outline a course of action to mitigate any plume movement. These measures include the plume monitoring program and contingency plan which will be formally proposed to the USEPA for review and approval during the remedial design process. USEPA and ARCADIS conducted a work session in September 2006 to review future groundwater monitoring plans (installation of additional deep monitoring well MW-07, etc.). Additional work sessions to discuss the details of plume monitoring will be conducted as necessary.

The sentry monitoring program will be established under approval the USEPA. Sentry well monitoring will be conducted monthly, quarterly, and semiannually for the first, second, and third years, respectively, following initiation of pumping at PW-01 and then will be rolled into the existing semi-annual groundwater monitoring program for the plume. In the event that the periodic monitoring program indicates that the plume is migrating towards PW-01, the two most likely responses are as follows: (a) the pumping rate at MUN-3 could be increased in order to expand the capture zone of MUN-3, and (b) a pumping program could be instituted at MUN-1, located between

MUN-3 and PW-01, to provide an effective cutoff of concentrations of VOCs escaping the capture zone of MUN-3. The two options presented above should be sufficient, either each by itself or in some combination, to control migration of the plume towards PW-01. However, based upon the results of the testing that has been conducted to date, plume migration is not expected.

To determine if the aquifer at the Well Site meets drinking water quality standards, groundwater samples were collected during the June 2005 and December 2005 pumping tests and analyzed for parameters in accordance with the PADEP new source sampling requirements for community groundwater sources (PADEP, 1998), 1,4-dioxane, and micro-particulates. Analytical results indicated no constituents were detected above PADEP MCLs for Community Groundwater Sources, for those constituents for which MCLs have been defined by PADEP. PADEP and USEPA have not established an MCL for 1,4-dioxane, and 1,4-dioxane was not detected above the laboratory detection limits (between 2.8 and 3.0 µg/L) in any sample collected from the Well Site. The micro-particulate analyte (MPA) samples are required to be collected where the potential exists for water to be drawn from surface water into the well. Analytical results indicated no particulates were identified. However, per PADEP requirements the well will have to undergo a six-month special monitoring program for the Surface Water Identification Procedure (SWIP) in addition to standard requirements for public water supply quality monitoring.

As part of this alternative evaluation an analysis was conducted to assess the integrity of the Bally potable water system for different pressurization regimes. These analyses were conducted by Bally's consultant for system operation, System Design Engineering (SDE). Analyses were run to evaluate pressurization of the system from different connection points including the north end of Bally where the planned connection point for the new system is located (Figure 6). The analyses indicated that the selected connection point generally provided equal or better system performance than the present connection at MUN-3.

The additional components of the Bally municipal water system required by this remedy will be constructed in accordance with the PADEP requirements for community water supply systems as described in the PADEP Public Water Supply Manual Part II Community System Design Standards The completed replacement well and associated components would be formally transferred to Bally following a one year warranty period. Thereafter, Bally would be responsible for upkeep and maintenance of the new system components. Once the appropriate regulatory approvals have been obtained, ARCADIS will begin final construction of the additional system components.

4.2.1.2 Continued Air Stripping Treatment at MUN-3

The air stripping treatment system at MUN-3 has been shown to be effective in treating the plume for VOCs. In the event a new municipal supply well is implemented, MUN-3 will continue to operate with the same treatment and sampling protocol currently in place as described in the ROD.

4.2.1.3 Pipeline Construction and Utilization to Discharge MUN-3 Effluent to West Branch Perkiomen Creek

Implementation of this alternative will require the construction of a new pipeline to discharge air stripper treatment system effluent to a PADEP approved location along the West Branch. The new location along the West Branch has greater channel flow and mixing capacity than the current discharge location. The PADEP has approved an NPDES permit for the treatment system effluent for a 1,4-dioxane concentration of 112 μg/L. Historical effluent concentrations for 1,4-dioxane have been well below this value.

4.2.2 Criteria Assessment for Alternative 1

The following sections provide an evaluation of the nine criteria that must be evaluated as part of the remedy selection process.

4.2.2.1 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment. The new public water supply will be sourced from an unimpacted aquifer region with demonstrated drinking water quality based on ARARs and proven sustainable yield based on aquifer testing. Assurance that pumping at the production well is not inducing migration of the identified plume toward the production well will be achieved through a sentry well monitoring program, which has been designed in conjunction with USEPA. While aquifer testing indicates plume migration is highly unlikely, viable options are available to counterbalance the effects of pumping at the production well and prevent impact to the drinking water supply in the event plume migration is observed. Historical Site data indicates that it would take in the range of 2-7 years for the plume to migrate from the 86-5 cluster to MW-04 if MUN-3 was not pumping. Treatment of the plume through air stripping at MUN-3 has proven to be effective at reducing concentrations of VOCs to meet the established ARARs, and this treatment strategy will continue for this alternative. The approved new discharge location along the West Branch Perkiomen

Creek has an appropriate channel flow to safely accommodate the expected 1,4-dioxane effluent concentrations through dilution/mixing.

4.2.2.2 Compliance with ARARs

This alternative complies with the regulatory requirements for drinking water and discharge to surface water. A permit from the PADEP's Water Supply and Management Section to operate the new public water supply well is an applicable regulatory requirement. Monitoring of 1,4-dioxane effluent concentrations will be conducted in accordance with the NPDES permit requirement. Drinking water ARARs for constituents that are required to be analyzed under PADEP new source sampling requirements are based on the respective MCLs for these constituents. The drinking water ARAR for 1,4-dioxane is based on the AOC which proposes a target of 3 μg/L. The Well Site is located in an unimpacted aquifer region beyond the limits of the identified plume. Analysis of groundwater sampling collected at the Well Site and from wells located nearly a mile to the southwest (towards the Site) indicated that no constituents were present above their respective ARARs. Operation of the public water supply system will require continued periodic water quality monitoring to ensure drinking water ARARs continue to be met. The discharge to surface water ARAR for 1,4-dioxane is 112 μg/L, based on the NPDES permit for the treatment effluent. Effluent concentrations of 1,4-dioxane at MUN-3 have historically been significantly below the ARAR and similar or declining levels are expected in the future. Monitoring of 1,4-dioxane effluent concentrations will be conducted periodically.

4.2.2.3 Long-term Effectiveness and Permanence

The new municipal supply well will be located in a portion of the aquifer located sidegradient to slightly upgradient of the Site. Water quality in the aquifer at the Well Site has been shown to meet the PADEP requirements for community water supply sources. Therefore, no treatment is anticipated beyond chlorination typical of any public water supply. Sunbeam will assist in the operation of the well for a one year warranty period after which Bally will take sole responsibility for the operation of the new well. This period will be used to ensure the proper mechanical operation of the well according to industry standards. The long-term success of this alternative will be dependent on the absence of plume capture by PW-01 and on the sustainable yield of the aquifer. Aquifer testing indicates that plume migration is not expected. As stated above, periodic sentry monitoring will be conducted to provide ample warning if plume migration does occur towards PW-01. Additionally, response strategies have been developed in the unlikely event that migration should occur. Based on the results of three pumping tests conducted at the Well Site, PW-01 was completed in an exceptional fault aquifer system and aquifer specific capacity, recovery rate, and late time drawdown projections indicate the 350 gpm yield at PW-01 is sustainable.

Discharge of the treatment effluent from MUN-3 to an approved location along the West Branch will enable dilution of residual concentrations of 1,4-dioxane to surface water concentrations in compliance with the PADEP issued NPDES requirements and ultimately a drinking water criterion of 3 μg/L. Concentrations of 1,4-dioxane in the effluent will continue to be monitored periodically to ensure that concentrations do not exceed the surface water ARAR

4.2.2.4 Reduction of Toxicity, Mobility or Volume through Treatment

Reduction of toxicity of 1,4-dioxane involves transfer of the contaminant mass from the groundwater to a surface water body with sufficient mixing capacity to safely accommodate the contaminant mass. Reduction of toxicity is, therefore, achieved by discharge to the West Branch. The maximum allowable effluent concentration of 1,4-dioxane discharged to the stream is 112 μg/L, based on an approved NPDES permit. Concentrations of 1,4-dioxane in effluent samples collected from MUN-3 from February 2003 through September, 2006 ranged from 24 μg/L to 77 μg/L. As these concentrations are already below the NPDES permitted effluent concentrations no additional treatment of 1,4-dioxane is required prior to discharging to the stream.

4.2.2.5 Short-term Effectiveness

The location of the proposed pumping well (PW-01) is outside of the extent of the identified groundwater plume. Therefore, the process of development of this well as a public water supply source will not introduce hazards to human health or the environment which exceed the normal hazards of constructing a public supply well facility. The estimated time to completion of a permitted new public water supply system is approximately one year, which includes securing the necessary permits and construction of the pumping well facility and distribution infrastructure. Bottled water will continue to be supplied to Bally municipal water system users during the permitting and construction period.

1,4-Dioxane contained in the effluent from MUN-3 will continue to be discharged at the present discharge location along the West Branch Perkiomen Creek and will not present an exposure hazard to workers during construction of the new pipeline. The environmental impact of pipeline construction includes wetland areas that will have to be crossed. Based upon the results of the Phase I bog turtle evaluation (Appendix B), it is recommended that a certified bog turtle habitat evaluator be present during construction in the previously delimited potential habitat area. The estimated construction time for the pipeline is 3 months. At the time of publication of this report the Pennsylvania Department of Transportation (PennDOT) permit was the only permit remaining outstanding. Once construction of the discharge pipeline is complete, effluent from MUN-3 can be discharged to the new location along the West Branch, regardless of construction status of the new public water supply.

4.2.2.6 Implementability

Completion of well PW-01 as a public water supply source and construction of the associated distribution infrastructure will involve standard technical procedures and materials with regulatory standards guiding implementation. Aquifer testing for the proposed Well Site has indicated that PW-01 is capable of sustainably supplying 350 gpm of drinking water, which will be more than sufficient to meet the anticipated water supply need. Water quality monitoring of the production well will be conducted in accordance with PADEP Community Water Source Monitoring, SWIP Monitoring, and the proposed sentry well monitoring plan, and will employ approved sampling protocol. The implementation of this alternative will also require additional permitting from state and local governing agencies prior to its construction and operation.

Construction of the discharge pipeline will be based on standard engineering design practices and utilize standard material and components. Monitoring of 1,4-dioxane concentrations in MUN-3 effluent will continue in accordance with the requirements of the NPDES permit to ensure that concentrations of 1,4-dioxane do not exceed the NPDES permitted effluent concentration of 112 μg/L, and will employ approved sampling procedures.

4.2.2.7 Cost

The estimated costs for implementation of this alternative are presented in Table 4. This cost estimate includes costs for the design, permitting and installation of the discharge pipeline, the new supply well and associated structures and the additional supply piping to connect the new well to the present system. The anticipated total costs for these activities are $3,266,000. Some of these costs have already been incurred by Sunbeam.

4.2.2.8 State and Support Agency Acceptance

State and support agency acceptance will be formally addressed following the submission of this report.

4.2.2.9 Community Acceptance

This will be formally addressed during the public comment period. However this alternative has a high likelihood of community acceptance. In a meeting with EPA representatives on August 28, 2006 the Borough council approved the plan to proceed with the new well.

4.2.3 Alternative 2 – Additional Treatment at MUN-3 Using Advanced Oxidation Processes

Under this Alternative 2, MUN- 3 would continue to operate and serve as a water source for the Bally PWS. The existing air stripper treatment system at MUN- 3 would also continue operating to remove VOCs present in the extracted groundwater. The water exiting the air stripper system would undergo an additional treatment step utilizing an advanced oxidation process (AOP) to chemically destroy the 1,4-dioxane present in the extracted groundwater. Figure 7 presents a system schematic of the present treatment system as it would be expanded to incorporate Alternative 2. The USEPA and PADEP have proposed a criterion of 3 μg/L as the target for the Bally PWS.

A comprehensive review of available remedial technologies to treat 1,4-dioxane in groundwater indicated that the best available technologies (BAT) for treatment of 1,4-dioxane under the relatively high flow regime existing at the Bally public water supply (PWS) are gaseous ozone (ozonation) and ultraviolet light/hydrogen peroxide (UV/peroxide) treatment. Other treatment technologies and variations of advanced oxidation processes (AOPs) exist, but are less attractive for a variety of reasons, including a lack of performance history and data for high flow regimes.

As described in an ARCADIS letter to the USEPA, Region III, dated 20 August 2003, (2003b) ARCADIS performed an evaluation of 1,4-dioxane treatment for the Bally PWS. 2003. As part of this evaluation, ARCADIS surveyed multiple vendors, operators and regulators of 1,4-dioxane treatment systems to assess other parties' experiences with treatment technologies. This evaluation also included bench-scale testing of the ozonation and UV/peroxide technologies on water samples collected from MUN- 3. These water samples were collected in March, April and June 2003 at a collection point located after air stripping but prior to chlorination.

The ozonation testing was performed by Michigan State University (MSU) and the UV/peroxide testing was performed by Trojan Technologies, Inc. (Trojan). Bench scale testing results included the following:

- The ozonation process reduced 1,4-dioxane concentrations from 60 μg/L to less than 1 μg/L after fifteen minutes of contact time with a 5% ozone feed into one liter of water;

- The UV/peroxide process reduced 1,4-dioxane concentrations from approximately 290 μg/L (a sample that was spiked with additional 1,4-dioxane) to less than 30 μg/L after 120 minutes of contact time using a 30-watt UV lamp;

- The ozonation process left a by-product residual of 13 μg/L of formaldehyde and 60 μg/L of bromate after fifteen minutes of contact time; and,

- The UV/peroxide process left a by-product residual of 42 μg/L of formaldehyde and no bromate in an un-spiked sample.

The evaluation found that there is a limited body of data on the effectiveness, performance, and practicability of ozonation and UV/peroxide treatment systems that treat for 1,4-dioxane. This limited data does not allow for a confident extrapolation of performance results to a system like the Bally PWS.

Of the fourteen treatment system regulators, vendors and operators that were identified and contacted for this evaluation, only one instance was found where an operating treatment system discharged water directly to a PWS. 1,4-Dioxane was not the primary contaminant of concern at this site, and the influent 1,4-dioxane concentrations for that treatment system were typically less than 3 μg/L. Over an order of magnitude lower than the concentrations typically detected at MUN- 3.

Systems with similar or higher concentrations of 1,4-dioxane as MUN- 3 did not discharge directly to a PWS and/or were configured in a manner that would be impractical for the Bally PWS. As such, there is no history of consistent treatment to 3 μg/L or less for influent 1,4-dioxane concentrations and flow rates similar to those observed at MUN- 3 and for a PWS similar to the Bally PWS.

4.2.3.1 Criteria Assessment for Alternative 2

The following sections provide and evaluation of the nine criteria that must be evaluated as part of the remedy selection process.

4.2.3.2 Overall Protection of Human Health and the Environment

This alternative is protective of human health and the environment with regards to exposure to 1,4-dioxane. This alternative would remove the 1,4-dioxane present in groundwater extracted at MUN- 3 by chemical destruction. However, residuals such as bromate and formaldehyde can form during treatment by ozonation or UV/peroxide. Avoidance of such byproduct formation would need to be guaranteed for any treatment system for MUN- 3.

During the bench-scale testing mentioned above, bromate was detected in water treated by ozonation at concentrations of approximately 50 to 60 μg/L. These concentrations are above the USEPA and PADEP MCL of 10 μg/L. Formaldehyde was detected in both water treated by ozonation and water treated by UV/peroxide. There is currently no MCL for formaldehyde. However, the USEPA has identified health concerns associated with the consumption of drinking water containing formaldehyde. ARCADIS' treatment technology evaluation found that consistent byproducts testing for compounds such as bromate and formaldehyde generally was not conducted in operating treatment systems. As such, ARCADIS' evaluation found that a definitive history of systems with documented absence of treatment byproducts that would be adequate for extrapolation to MUN- 3 was not clearly evident.

Further testing of 1,4-dioxane treatment systems would have to be performed because of the generation of potentially harmful treatment byproducts. This would include further bench-scale testing in addition to conducting pilot-scale testing prior to implementation of a full-scale treatment system at MUN- 3.

4.2.3.3 Compliance with ARARs

This alternative may not comply with the site related ARARs for drinking water and discharge to surface water due to the substantial possibility that production of bromate or formaldehyde may occur. The most stringent drinking water TBC for 1,4-dioxane is based on a proposed target of 3 μg/L for this compound for the Site. Based upon the evaluation of the treatment system performance described above, consistent achievement of 1,4-dioxane concentrations below 3 μg/L may not be feasible.

4.2.3.4 Long-Term Effectiveness and Performance

Alternative 2 would not provide an effective long-term remedy for the presence of 1,4-dioxane in groundwater extracted from MUN-3. This alternative would remove 1,4-dioxane from groundwater extracted at MUN- 3 because this alternative would chemically destroy the 1,4-dioxane. Under these conditions, the amount of 1,4-dioxane that would enter the Bally PWS and the nearby receiving stream would be greatly reduced. However, the ability of a treatment system to consistently meet a 3 μg/L treatment threshold is uncertain. In addition, there is a possibility that undesirable byproducts would be produced. Therefore, given the present state of the treatment technologies available, this alternative would not be effective if implemented.

This alternative would incur significant ongoing operating and maintenance costs, and a long-term operation and maintenance program would have to be implemented for this alternative to ensure that the AOP treatment system is working properly. Monitoring for treatment byproducts may also have to be implemented depending on the results of additional studies and the AOP treatment system chosen. However, the addition of a treatment system at MUN- 3 would also provide the infrastructure to upgrade the treatment in the event that better technology is developed in the future.

4.2.3.5 Reduction of Mobility, Toxicity, or Volume

This alternative utilizes AOPs that can chemically destroy the 1,4-dioxane in groundwater that is extracted from MUN- 3. Therefore, this treatment technology reduces the mobility, toxicity, and volume of 1,4-dioxane. However, as noted above, undesirable residual reaction byproducts may be present in the treated effluent. AOP treatment may result in the formation of bromate and or formaldehyde as reaction byproducts that are not presently in the treatment system effluent.

4.2.3.6 Short-Term Effectiveness

Following the additional pilot study work that would have to be performed prior to implementation, an AOP treatment system will be able to meet its objectives for 1,4-dioxane removal relatively quickly. The permitting and construction of a treatment system at MUN- 3 will take several months. Construction would not impact any undeveloped land and would occur entirely on property owned by the Borough of Bally. Once activated, the treatment system would be able to reduce 1,4-dioxane concentrations immediately. However, the ability of the treatment system to consistently reduce 1,4-dioxane below 3 μg/L is uncertain without further testing.

Workers would not be exposed to any groundwater contaminants throughout most of construction.

4.2.3.7 Implementability

Prior to construction of the full-scale AOP treatment system, a pilot test would have to be performed to further evaluate the treatment technology. More extensive pilot testing would be required in order to use this technology for drinking water treatment. Once a successful pilot test has been conducted, this technology could be readily put into place due to its modularity. This alternative would require the expansion of the existing facilities at MUN- 3, such as the electrical service, in order to accommodate the installation and operation of the treatment system. The implementation of this alternative would also require additional permitting from state and local governing agencies prior to its construction and operation.

4.2.3.8 Cost

The estimated costs for implementation of this alternative are provided in Table 5. This cost estimate assumes that UV/peroxide treatment would be the AOP utilized at MUN-3. These costs include a pilot study, the construction of a building and electrical service to accommodate the UV/peroxide treatment system, the treatment system components and controls, and thirty years of operation and maintenance costs for the treatment system. The estimated cost for this option is approximately $4,373,000.

4.2.3.9 State/Support Agency Acceptance

Present indications are that the USEPA and PADEP would prefer another remedy; however, State and support agency acceptance will be formally addressed following the submission of this report.

4.2.3.10 Community Acceptance

A Bally Borough official has indicated that additional treatment at MUN-3 would not be acceptable to the Bally Borough Council. However, this aspect will be formally addressed during the public comment period.

5. Recommended Alternative

Installation of a new groundwater source has been identified as the best option under the presently existing conditions. The following sections compare Alternatives 1 and 2 as implementable remedies.

5.1 Comparative Analysis of Options

Both Alternatives 1 and 2 provide solutions that would provide an implementable long term solution to remove 1,4-dioxane from the Bally PWS. However, in the short term Alternative 1 is more effective as this alternative does not require the additional bench and pilot scale testing required as part of Alternative 2 are unnecessary. Therefore it is anticipated that Alternative 1 would provide 1,4-dioxane free water flowing to Bally residents sooner than Alternative 2.

Analysis indicates that Alternative 2 would provide a greater reduction of toxicity, volume and mobility of 1,4-dioxane as it would destroy the chemical structure of the 1,4-dioxane molecule. However, Alternative 2 may also produce undesirable byproducts. Alternative 1 would not directly destroy the 1,4-dioxane molecule. However, it would place the 1,4-dioxane in a situation where it can be more readily degraded by natural processes. Dilution/mixing would instantly decrease the concentration of 1,4-dioxane below 3 μg/L.

Alternative 1 can be more readily implemented than can Alternative 2 as it is founded upon established technology and will provide Bally with a system that is equivalent or simpler (to operate) than its present water supply system. Additionally, system maintenance and repairs when required would not typically require highly specialized training as would Alternative 2.

A cost comparison of Alternatives 1 and 2 is presented in Table 6. This table reveals that while Alternative 1 requires more than twice the initial capital cost outlay, the annual O&M costs for Alternative 1 are approximately one quarter of the Alternative 2 annual O&M costs. Therefore, the total cost for Alternative 1 is significantly lower than Alternative 2 over the period of operation.

5.2 Recommended Alternative

Given all of the above factors, Alternative 1 is the recommended option to address the 1,4-dioxane concentrations in the Bally PWS.

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Table 1 Bally Well No. 3 Effluent Analytical Results for 1,4-Dioxane

Bally Groundwater Contamination Site Municipal Water Supply, Bally, Pennsylvania

Date	1,4-Dioxane Effluent Conc. (ug/L)	Laboratory	Date	1,4-Dioxane Effluent Conc. (ug/L)	Laboratory
2/5/2003	53.7	ALS	7/3/2003	31	STL
2/12/2003	60.5	ALS	7/3/2003	32*	STL
2/19/2003	40	STL	7/10/2003	34	STL
3/6/2003	30	STL	7/17/2003	32	STL
3/6/2003	31*	STL	7/24/2003	42	STL
3/28/2003	44	STL	7/31/2003	42	STL
4/3/2003	35	STL	8/7/2003	39	STL
4/3/2003	42*	STL	9/5/2003	32	STL
4/10/2003	43	STL	9/18/2003	32	STL
4/17/2003	38	STL	10/3/2003	35	STL
4/24/2003	30	STL	10/21/2003	35	STL
5/1/2003	39	STL	11/15/2003	27	STL
5/1/2003	40*	STL	12/4/2003	32	STL
5/8/2003	33	STL	1/7/2004	37	STL
5/15/2003	34	STL	2/4/2004	62	STL
5/22/2003	37	STL	3/4/2004	35	STL
5/29/2003	40	STL	4/7/2004	41	STL
6/5/2003	32	STL	5/30/2004	31	STL
6/5/2003	38*	STL	6/16/2004	43	STL
6/12/2003	35	STL	7/7/2004	24	STL
6/19/2003	25	STL	8/4/2004	33	STL
6/26/2003	37	STL	9/1/2004	50	STL

Table 1 Bally Well No. 3 Effluent Analytical Results for 1,4-Dioxane

Bally Groundwater Contamination Site Municipal Water Supply, Bally, Pennsylvania

Date	1,4-Dioxane Effluent Conc. (ug/L)	Laboratory	Date	1,4-Dioxane Effluent Conc. (ug/L)	Laboratory
9/8/2004	50	STL	6/16/2005	65.1	ALS
10/8/2004	34	STL	6/23/2005	38	ALS
11/4/2004	47	STL	6/29/2005	65.2	ALS
12/2/2004	29	STL	7/7/2005	51.9	ALS
1/6/2005	34	STL	7/14/2005	55.3	ALS
2/16/2005	67.2	ALS	7/20/2005	52	ALS
2/23/2005	66.6	ALS	7/29/2005	52.6	ALS
3/1/2005	49.3	ALS	8/5/2005	55.3	ALS
3/10/2005	47.5	ALS	8/10/2005	56.6	ALS
3/16/2005	54.8	ALS	8/17/2005	51.3	ALS
3/22/2005	48.3	ALS	8/24/2005	45.3	ALS
3/29/2005	38.1	ALS	8/31/2005	39.8	ALS
4/6/2005	53.8	ALS	9/7/2005	32.4	ALS
4/14/2005	49.7	ALS	9/15/2005	51.8	ALS
4/20/2005	51.5	ALS	9/22/2005	63.1	ALS
4/28/2005	50.8	ALS	9/28/2005	63.1	ALS
5/5/2005	49	ALS	10/6/2005	40.8	ALS
5/12/2005	44	ALS	10/13/2005	54	ALS
5/18/2005	67.3	ALS	10/19/2005	55	ALS
5/26/2005	51.1	ALS	10/26/2005	56.8	ALS
6/2/2005	60.9	ALS	11/1/2005	53.8	ALS
6/9/2005	60.4	ALS	11/10/2005	72.2	ALS

Table 1 Bally Well No. 3 Effluent Analytical Results for 1,4-Dioxane

Bally Groundwater Contamination Site Municipal Water Supply, Bally, Pennsylvania

Date	**1,4-Dioxane Effluent Conc. (ug/L)**	**Laboratory**	**Date**	**1,4-Dioxane Effluent Conc. (ug/L)**	**Laboratory**
11/16/2005	54.3	ALS	4/13/2006	73.5	ALS
11/23/2005	40.3	ALS	4/20/2006	77	ALS
11/30/2005	40.3	ALS	4/26/2006	61.1	ALS
12/7/2005	30.8	ALS	5/4/2006	52	ALS
12/14/2005	54.9	ALS	5/11/2006	60.9	ALS
12/21/2005	53.6	ALS	5/17/2006	47.6	ALS
12/29/2005	68.8	ALS	5/24/2006	50	ALS
1/4/2006	68.6	ALS	6/1/2006	65.1	ALS
1/11/2006	53.6	ALS	6/7/2006	63.5	ALS
1/18/2006	44.2	ALS	6/15/2006	64.1	ALS
1/25/2006	45.4	ALS	6/21/2006	58.9	ALS
2/2/2006	54.6	ALS	6/28/2006	60.7	ALS
2/8/2006	58.2	ALS	7/7/2006	51.3	ALS
2/16/2006	58.9	ALS	7/13/2006	59.4	ALS
2/22/2006	56.9	ALS			
3/1/2006	60.3	ALS			
3/9/2006	55.7	ALS			
3/22/2006	60.1	ALS			
3/29/2006	50.6	ALS			
4/6/2006	62.6	ALS			

Notes:

* Duplicate sample

ALS: Analytical Laboratory Services, Inc.

STL: Severn Trent Laboratories, Inc.

Table 2. Chemical-Specific Relevant and Appropriate To-Be-Considered Requirements for 1,4-Dioxane[1] in Drinking Water, Bally Groundwater Contamination Site, Bally, Pennsylvania.

Agency	Guidance Type	Guidance Criteria (ug/L)
California Department of Health Services	Notification Level (NL)	3
Maine Department of Environmental Protection	Maximum Exposure Guideline (MEG)	32
Massachussets Department of Environmental Protection	Office of Research and Standards Guideline (ORSG)	3
Michigan Department of Environmental Quality	Drinking Water Advisory	85
USEPA Region 1	CT DPH Risk Analysis	20
USEPA Region 2	NY DOH Health Standard	50
USEPA Region 3	Administrative Order on Consent (AOC) for BES site	3 [2] 6 [3]
USEPA Region 9	Preliminary Remedial Goal (PRG)	6.1
USEPA Office of Solid Waste & Emergency Response	RCRA Action Level [4]	3
USEPA Office of Water	SDWA Health Advisory [5]	4,000 [ch/1d] [4] 400 [ch/10d] [5] 700 [ca risk] [6]

Notes:

[1] 1,4-Dioxane CASRN # 123-91-1

[2] Consumption of drinking water containing this level of 1,4-dioxane over a 70-year period presents an excess cancer risk of $1x10^{-6}$. USEPA selected this level in the AOC as the drinking water requirement for the BES site.

[3] Consumption of drinking water containing this level of 1,4-dioxane over a 30-year period presents an excess cancer risk of $1x10^{-6}$

[4] Child one-day health advisory: the concentration in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to 5 consecutive days of exposure, with a margin of safety

[5] Child ten-day health advisory: the concentration in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to 14 consecutive days of exposure, with a margin of safety

[6] Concentration in drinking water which presents a 10^{-4} cancer risk, estimated for a 10-kg child or 70-kg adult consuming 2 liters of water per

CT DPH: Connecticut Department of Public Health

NY DOH: New York Department of Health

RCRA: Resource Conservation and Recovery Act

SDWA: Safe Drinking Water Act

Table 3. 1,4-Dioxane Treatment Technology Comparison, Bally Groundwater Contamination Site, Bally, Pennsylvania

Technology	Surface Water Discharge	Municipal Water Supply	Retained	Drawback
Granular Activated Carbon	Not suitable	Not suitable	NO	Poor adsorption characteristics (0.5-1.0 miligram of 1,4-dioxane per gram of carbon at 500 ppb)
Ozone-Catalyzed Hydrogen Peroxide	Technically suitable; likely more costly than direct ozonation	Technically suitable; likely more costly than direct ozonation	Yes	Hydrogen peroxide handling, additional operation cost
Direct Ozonation	Technically suitable, may be cost-effective	Technically suitable, may be cost-effective	Yes	Reaction time is longer than Ozone/Hydrogen Peroxide method
Titanium Dioxide Photo-Catalytic Oxidation	Technically suitable, may be cost-effective	Not suitable	No	Lack of prior applications to municipal water supply systems; catalyst recovery unit for TiO2 slurry recapture may not be suitable for water supply applications
UV/Hydrogen Peroxide Oxidation	Technically suitable, may be cost-effective	Technically suitable, may be cost-effective	Yes	Hydrogen peroxide handling, additional operation cost
Phyto Remediation	Not feasible for pump & treat use	Not feasible for pump & treat use	No	Requires large amount of space, no enough treatment efficiency
Ultrasonic System	Potential technology, but still in the development phase	Not suitable for municipal water supply until it's out of the development phase	No	Cost and oxidation efficiency are questionable
"Negative Growth" Bio-Reactors	Technically suitable The capital cost may be noticeably lower	Not suitable	No	The operating cost will be high, and beyond the ability of Bally municipal workers

Table 4. Cost Estimate for Alternative 1: Groundwater Supply Well Installation and Operation, Bally Groundwater Contamination Superfund Site, Bally, Pennsylvania.

Contingency 15%				
	Quantity	**Unit**	**Cost Per Unit**	**Total**
Supply Well Permitting and Installation				
Site Evaluation and Property Access	1	LS	$221,739	$221,739
Drilling and Aquifer Pumping Test	1	LS	$314,783	$314,783
Reporting and Permitting	1	LS	$202,609	$202,609
Design and Construction (Well House, Supply Pipeline, etc.)	1	LS	$782,609	$782,609
Discharge Pipeline				
NPDES Permitting	1	LS	$96,522	$96,500
Pipeline Access Negotiation	1	LS	$17,391	$17,400
Design and Construction (Treatment System Modifications, Discharge Pipeline, etc.)	1	LS	$506,957	$507,000
Supply Well and Discharge Pipeline Cost Subtotal:				$2,142,600
Contingency:				$321,400
Supply Well and Permitting Cost Total:				$2,464,000
	Quantity	**Unit**	**Cost Per Unit**	**Total**
Annual O&M of Existing Pump and Treat System				
System O&M (physical repairs/maint., electrical power, etc.)	1	LS	$29,165	$29,200
System Influent & Effluent Analyses and Data Review, DMRs	1	LS	$21,217	$21,200
Annual O&M Cost Subtotal:				$50,400
Contingency:				$7,600
Annual O&M Cost Total:				$58,000
Present Value for Alternative 1 2006 through 2025				$3,266,000

Notes:

All costs are based on an accuracy of +50/-30% (USEPA, 2000)
30-yr Discount Rate of 3.4% based on the 5-yr (2001-2005) average of the Real Treasury Discount Rate (OMB, 2005); calculations based on beginning 30-yr period in 1995

LS = Lump Sum
NA = Not Applicable
O&M = Operation and Maintenance
OMB = Office of Management and Budget
USEPA = United States Environmental Protection Agency

Table 5. Cost Estimate for Alternative-2: Municipal Well No. 3 Treatment, Bally Groundwater Contamination Superfund Site, Bally, Pennsylvania.

Contingency 15%

	Quantity	Unit	Cost Per Unit	Total
Treatment System Design, Permitting and Installation				
Treatment System Evaluation and Bench-Scale Testing	1	LS	$30,435	$30,435
Treatment System Pilot Test and Report	1	LS	$69,565	$69,565
Treatment System Design and Permitting	1	LS	$165,217	$165,217
Building, Treatment Units, Tanks, Electrical Service, Controls				
Mobilization	1	LS	$ 13,043	$ 13,043
Building				
Site preparation/strip topsoil	1	LS	$ 13,043	$ 13,043
Extend gravel driveway	1	LS	$ 3,478	$ 3,478
Excavation for concrete slab foundation	1	LS	$ 6,522	$ 6,522
Stone subbase for concrete slab foundation (6")	14	CY	$ 30	$ 428
Cast-in-place conc. slab foundation (19'x40'x8", 4000 psi, WWF reinf)	19	CY	$ 870	$ 16,522
Sonotube piers or grade beams under slab foundation	1	LS	$ 6,522	$ 6,522
Pre-engineered metal building (18'Wx38'Lx10'H)	684	SF	$ 30	$ 20,817
Building insulation	1	LS	$ 6,957	$ 6,957
Roll-up door	1	EA	$ 2,174	$ 2,174
Man-door	1	EA	$ 1,304	$ 1,304
Tank (Chemical Storage)				
Cast-in-place conc slab for tank (10'x10'x8"), incl excav and piers	3	CY	$ 1,304	$ 3,913
Reagent tank (incl. in UV System Equipment price)	0	EA	$ 4,348	$ -
Insulation for tank	1	LS	$ 870	$ 870
Piping for tank	1	LS	$ 2,609	$ 2,609
Pump/mixer/float switches for tank (incl. in UV System Equipment price)	0	LS	$ 3,478	$ -
Electrical Construction				
New electrical service to building (20 kW, 3 phase)	1	LS	$ 21,739	$ 21,739
Electric heaters within building	1	LS	$ 2,609	$ 2,609
Other elec. constr. w/in bldg (lights, control wiring, etc.)	1	LS	$ 2,609	$ 2,609
Controls				
PLC/controls for UV system	1	LS	$ 3,478	$ 3,478
Re-program exist. PLC to connect UV system	1	LS	$ 4,348	$ 4,348
UV System Equipment				
Pilot Treatment System	4	Month	$ 17,391	$ 69,565
Permanent Treatment System	2	LS	$ 169,472	$ 338,944
Chlorination system modifications	1	LS	$ 13,043	$ 13,043
Other Construction				
Piping mods. w/in existing treatment plant (incl. connection to UV system)	1	LS	$ 4,592	$ 4,592
			Treatment System Cost Subtotal:	$824,300
			Contingency:	$123,600
			Treatment System Cost Total:	$947,900
	Quantity	Unit	Cost Per Unit	Total
Annual O&M of Modified Pump and Treat System				
System O&M (physical repairs/maint., electrical power, etc.) - existing system	1	LS	$29,165	$29,200
System Influent & Effluent Analyses and Data Review, DMRs - existing system	1	LS	$21,217	$21,200
Additional treatment system influent & effluent analyses (lab costs)	1	LS	$15,652	$15,700
Additional treatment system electrical cost due to UV-Ox	1	LS	$34,783	$34,800
Additional Operator Labor (1/2 time), labor and expenses/mileage	1	LS	$84,000	$84,000
Lamp replacement	1	LS	$14,783	$14,800
Hydrogen peroxide (9 ppm, $4.50/gal)	1	LS	$15,652	$15,700
			Annual O&M Cost Subtotal:	$215,400
			Contingency:	$32,300
			Annual O&M Cost Total:	$247,700
			Present Value for Alternative 2 2006 through 2025	$4,373,000

Notes:

All costs are based on an accuracy of +50/-30% (USEPA, 2000)
30-yr Discount Rate of 3.4% based on the 5-yr (2001-2005) average of the Real Treasury Discount Rate (OMB, 2005); calculations based on beginning 30-yr period in 1995
NA = Not Applicable
O&M = Operation and Maintenance
OMB = Office of Management and Budget
USEPA = United States Environmental Protection Agency

Table 6 Cost Estimates[1] for Public Water Supply and Groundwater Treatment Options, Bally Groundwater, Contamination Site, Bally, Pennsylvania.

Remedial Alternative	Description	Capital Cost ($)	Annual O&M Cost ($)	Present Value[2] ($)
Alternative - 1	Replacement Supply Well Installation and Operation	$2,464,000	$58,000	$3,266,000
Alternative - 2	UV/Hydrogen Peroxide Oxidation	$947,900	$247,700	$4,373,000

Notes:

1	All costs are based on an accuracy of +50/-30% (USEPA, 2000)
2	30-yr Discount Rate of 3.4% based on the 5-yr (2001-2005) average of the Real Treasury Discount Rate (OMB, 2005); based on beginning 30-yr period in 1995
NA	Not Applicable
O&M	Operation and Maintenance
OMB	Office of Management and Budget
USEPA	United States Environmental Protection Agency

Table 7. Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane[1] in Bally Groundwater
Bally Groundwater Contamination Site, Bally, Pennsylvania.

ARAR or TBC	Location/Medium	Citation	Description/Requirement	Classification	Applicability to Selected Remedy
ARAR	Floodplains	40 CFR 6.302(b) Executive Order No. 11988	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development if a practicable alternative exists. Evaluate potential effects of actions that may be taken in floodplains and ensure that planning and budgeting reflect consideration of flood hazards and floodplain management.	Applicable to activities conducted within a 100-year floodplain.	Portions of the proposed system will be located within the delineated 100-year floodplain zones. Generally, most construction activities during system implementation will be located at elevations above this delineation, and will not adversely impact these zones. Operation and maintenance of the treatment system will be conducted to prevent any washout of waste during 100-year flood events. Stream encroachments and utility line crossings will be reviewed and approved by the Conservation District through the Pennsylvania General Permit process prior to construction.
		40 CFR 6 Appendix A	Provide leadership and take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains.		
		40 CFR 264.18(b)	Design, construct, operate, and maintain facility in manner that prevents washout of any hazardous waste by a 100-year flood.		
		PA Code Title 25 Chapters 105 and 106	Plan, design, construct, maintain and monitor to prevent unreasonable interference with water flow, protect natural resources and water quality, and protect health, safety, welfare and property from flooding.		
ARAR	Wetlands	40 CFR 6.302(a) 40 CFR 6 Appendix A Executive Order No. 11990 40 CFR 230.3(t)	Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the destruction, loss, or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists. Provide leadership and take action to minimize destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.	Relevant and appropriate to wetland areas.	Wetland areas have been identified on and in the vicinity of the BES site. Precautions have and will be taken to ensure that wetlands are not impacted during implementation of the proposed treatment system. Stream encroachments and utility line crossings will be reviewed and approved by the Conservation District through the Pennsylvania General Permit process prior to construction.
		PA Code Title 25 Chapter 105	Plan, design, construct, maintain and monitor to protect natural resources, environmental rights and values and conserve and protect the water quality and natural regime. Avoid, to the extent possible, or minimize long and short term adverse impacts associated with the destruction, loss, or modification of wetlands and to avoid direct or indirect support of new construction in wetlands if a practicable alternative exists.		
ARAR	Sensitive Ecosystems: Fish and Wildlife Resources	40 CFR 6.302(g) Fish and Wildlife Coordination Act (16 USC 661 et. seq.)	Take action to protect fish and wildlife resources, which may be affected by actions that will result in the control or structural modification of any natural stream or body of water for any purpose. Mitigate, prevent, and compensate for project-related losses of wildlife resources and enhance these resources.	Not applicable to activities conducted.	Although the existing wetland areas provide potential habitat for protected species (bog turtle), Phase I and II surveys concluded that these species were not present in areas that will be disturbed during construction associated with proposed activities.

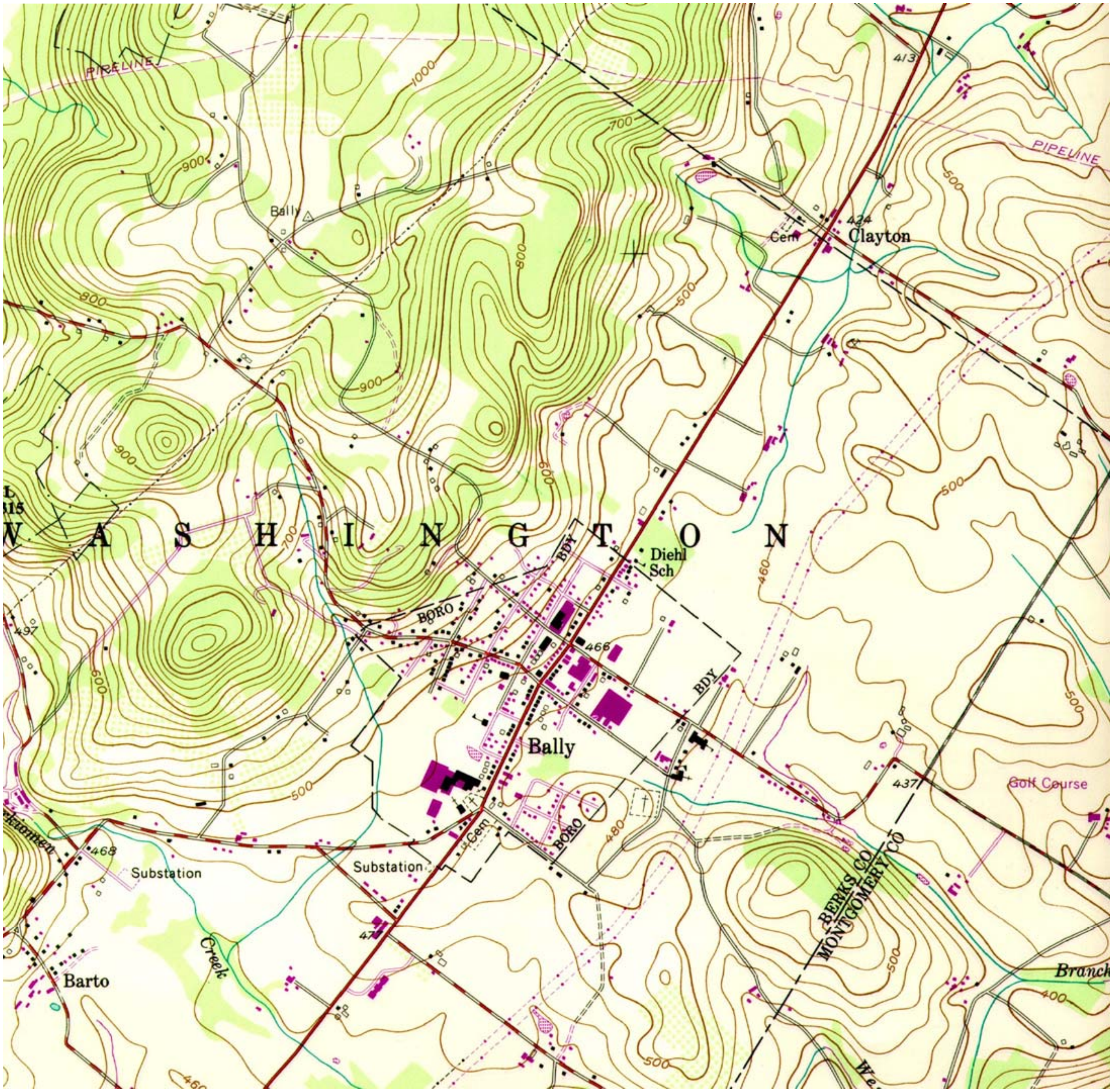
Notes:
[1] 1,4-Dioxane CASRN # 123-91-1
ARAR Applicable or Relevant and Appropriate Requirements
TBC To Be Considered
USC United States Code
CFR Code of Federal Regulations
DRB Delaware River Basin Commission

Table 7. Applicable Relevant and Appropriate and To-Be-Considered Requirements for 1,4-Dioxane[1] in Bally Groundwater
Bally Groundwater Contamination Site, Bally, Pennsylvania.

ARAR or TBC	Location/Medium	Citation	Description/Requirement	Classification	Applicability to Selected Remedy
ARAR	Groundwater	DRBC Water Code Article 2.20.7	Take action to register any well system withdrawing an average of at least 10,000 gallons/day for any 30-day period within the Delaware River Basin.	Relevant and appropriate to activities conducted.	Well records have already been provided to PADEP, and any supply well will be registered once permanent pumping equipment is installed.
ARAR	Groundwater, Surface Water and Drinking Water	DRBC Water Code Articles 2.50.3B.1 and 3.20.6	Take action to perform annual reporting meeting the requirements for public water supplies and meet applicable requirements for DRBC Zone 1E.	Relevant and appropriate to activities conducted.	The Borough of Bally will provide the DRBC with annual reports, including Source Data and Service Area Data, and, as appropriate, will adhere to the acceptable conditions for Water Uses to be Protected, Stream Quality Objectives, and Effluent Quality Requirements.
ARAR	Land and Surface Water	PA Code Title 25 Chapters 92 and 102 40 CFR 122.26(c)	Take action to implement and maintain erosion and sediment control measures for any earthmoving activities, and develop and implement an approved erosion and sediment control plan for any land disturbance over 5,000 square feet and obtain a NPDES permit for disturbances over 1 acre.	Relevant and appropriate to construction activities.	Construction activities for remedy implementation will utilize and maintain erosion and sediment control best management practices (BMPs), and will have approved plans and NPDES permits as needed.
TBC	Surface Water	NPDES Permit for BES Site Permit # PA 0055123	Operate and maintain the water treatment system within compliance of the constituent concentrations specified in the permit, prior to discharge at the outfall in West Perkiomen Creek.	Relevant and appropriate to activities conducted.	Interim monitoring activities at the discharge outfall will continue to demonstrate compliance with DEP requirements.
TBC	Groundwater and Drinking Water	DRBC Water Code Article 2.1.2C, 2.20.4, 2.50.1, 2.50.2A	Take action to limit groundwater withdrawals to the maximum draft of all withdrawals from an aquifer that can be reliably sustained without impacting ground water levels, water quality or perennial streams. Measurements of groundwater withdrawals and public water usage at individual premises shall be implemented. A water conservation plan shall be required for a new groundwater withdrawal	Relevant and appropriate to activities conducted.	The effects of pumping have been thoroughly evaluated as documented in the ARCADIS March 2006 Detailed Hydrogeologic Water Resources Investigation Report. The Borough of Bally has a water conservation plan and ordinance requiring metering at premises connected to public water.
TBC	Drinking Water	Administrative Order on Consent (AOC) for BES site # SDWA-03-2003-0301	Design, construct, operate, and maintain facility in manner that provides drinking water with 1,4-dioxane concentrations below the established AOC concentration. Take action until establishment of said facility to provide an alternative drinking water supply, thereby preventing short term adverse impacts associated with the consumption of 1,4-dioxane impacted drinking water.	Relevant and appropriate to activities conducted.	The current AOC governs the evaluation of the selected remedy and establishes provisions for treatment of the drinking water supply.

Notes:

[1] 1,4-Dioxane CASRN # 123-91-1
ARAR Applicable or Relevant and Appropriate Requirements
TBC To Be Considered
USC United States Code
CFR Code of Federal Regulations
DRB Delaware River Basin Commission



SCALE 1:24000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

QUADRANGLE LOCATION

MN GN 11 ½° 204 MILS 0°07' 2 MILS

UTM GRID AND 1985 MAGNETIC NORTH

SOURCE: USGS 7.5 MIN. TOPOGRAPHICAL QUADRANGLES EAST GREENVILLE, PENNSYLVANIA 1967, PHOTOREVISED 1985.

Path\Name: G:\APROJECT\AH Bally, PA\CADD\Focused Feasibility Study\FIG-01 SITE LOCATION.dwg
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Acad Version: 16.1s (LMS Tech) User Name: Slattery, Carol

Department Manager	M. BEDARD
Project Director	M. WOLFERT
Technical Review	C. SHARPE
Checked	

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SUNBEAM PRODUCTS INC.
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SITE LOCATION MAP

BALLY, PA

Project Number: NP000597.0002

Drawing Date: 28 AUGUST, 2006

Figure: 1

Department Manager	M. BEDARD
Project Director	M. WOLFERT
Technical Manager	C. SHARPE
Checked	J. BUTERA

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BALLY FOCUSED FEASIBILITY STUDY

GEOLOGIC BASEMAP

BALLY, PA

Project Number: NP000597.002

Date: 28 AUGUST, 2006

Figure: 2

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Acad Version: 16.2s (LMS Tech)

92-18I	6/7/99	1/10/00	7/24/00	1/24/01	8/6/01	1/21/02	7/9/02	9/12/02	2/27/03	3/25/03	10/14/03	3/16/04	10/7/04	3/29/05	9/21/05	9/21/05 D	3/8/06	3/8/06 D
1,4-Dioxane	--	--	--	--	--	--	--	--	<10	<0.7	<5	2.2 J	<3	<2.8	<2.8	<2.8	<2.8	<2.8
1,1-Dichloroethene	18	25	14	15	8.66	16.7	65.5	20.6	8.2	12	12	13	10	8.7	7.4	4.6	6.5	5.7
Trichloroethene	26	37	26	23	15.6	19	38.8	38.6	19	21	17	22	19	19	16	18	16	17
Tetrachloroethene	<1	<1	<1	<1	--	<1	1.24	<1	<1	<0.2	<0.60	<1	0.27 J	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	12	16	8.0	9.0	<5	10.6	22.9	9.77	4.5	6.1	5.1	5.6	<5	5.2	4.5	6.6	3.9	3.8

87-7I	1/9/88	1/31/89	3/1/89	3/14/89	4/5/89	5/5/89	6/2/89	7/6/89	1/15/93	5/12/93	3/25/03	12/14/05
1,4-Dioxane	--	--	--	--	--	--	--	--	--	--	<0.8	<2.9
1,1-Dichloroethene	14	3.0	8.0	5.0	4.0	5.0	20	20	4.9	9.3	6.4	<1
Trichloroethene	15	10	14	9.0	9.0	8.0	20	37	3.4	9.7	4.7	<1
Tetrachloroethene	--	<1	<1	<1	<1	<1	<1	<2	<1	<1	<0.2	--
1,1,1-Trichloroethane	47	4.0	6.0	8.0	9.0	13	70	120	<1	28	6.2	<1

Municipal Well No. 3	11/17/82	7/5/83	12/28/83	11/27/84	3/26/85	8/27/85	1/9/88	10/7/91	11/4/91	12/2/91	1/6/92	2/3/92	4/6/92	1/7/93	5/13/93	3/5/03	12/2/04	1/5/05	1/3/06	7/6/06
1,4-Dioxane	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31	29	34	68.6	51.3
Dichloroethene, 1,1-	--	--	--	423	457.6	434.8	290	1100	900	1100	1400	1500	740	740	210	145	256	283	336	272
Trichloroethene	3531	619.4	374	842	901.6	715.1	260	1900	1800	1700	2000	1500	1500	2000	900	462	495	563	609	466
Tetrachloroethene	--	4.4	--	--	--	--	--	<100	<100	<100	<100	<100	<100	<130	15	3.0	7.2	5.8	6.2	4.9
Trichloroethane, 1,1,1-	717	3139.4	3234	2778.8	4471.6	3585.3	640	2600	2500	2500	2600	2200	2000	2200	930	388	517	606	641	519
Dichloroethene, cis-1,2-	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

92-19I	1/10/00	1/24/01	1/21/02	2/27/03	3/16/04	3/28/05	3/8/06
1,4-Dioxane	--	--	--	<10	<3.0	<2.8	<2.6
1,1-Dichloroethene	3.0	4.0	2.98	2.6	4.2	2.0	2.2
Trichloroethene	7.0	5.0	5.6	4.6	4.3	2.3	3.4
Tetrachloroethene	<1	<1	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	6.0	3.0	3.97	2.6	3.3	1.6	2.0

Municipal Well No. 1	11/17/82*	7/5/83	9/15/83	11/27/84	3/26/85	8/27/85	5/12/86*	1/9/88	1/19/93	5/13/93	12/28/93	2/1/03	3/6/03	3/6/03 D
1,4-Dioxane	--	--	--	--	--	--	--	--	--	--	--	<10	<0.5	<0.5
Dichloroethene, 1,1-	--	--	1	1.6	3.9	3.82	5	19	2.2	<1	--	<1	0.6	1.1
Trichloroethene	ND	2.59	5	3.7	6.8	7.46	10	15	1.3	1.6	1.47	0.35	0.3	0.4
Tetrachloroethene	--	0.1	--	--	--	--	ND	--	<1	<1	--	<1	<0.2	<0.2
Trichloroethane, 1,1,1-	ND	1.85	--	19.5	46.6	48.29	46	73	5.3	4.7	4.17	0.37	0.6	0.6
Dichloroethene, cis-1,2-	--	--	--	--	--	--	--	--	--	--	--	<1.0	<0.3	0.6

* SEE NOTE 4

97-23I	1/10/00	1/24/01	1/21/02	2/26/03	3/25/03	3/25/03 D	3/16/04	10/7/04	3/29/05	3/9/06
1,4-Dioxane	--	--	--	5.7 J	<0.7	<0.7	9.2	<3	<2.8	<2.8
1,1-Dichloroethene	<1	<1	<1	<1	0.3	<0.3	<1	<1	<1	<1
Trichloroethene	<1	<1	<1	0.47	0.5	0.4	0.35 J	<1	<1	<1
Tetrachloroethene	<1	<1	<1	<1	<0.2	<0.2	<1	<1	<1	<1
1,1,1-Trichloroethane	<1	<1	<1	<1	<0.3	<0.3	<1	<1	<1	<1

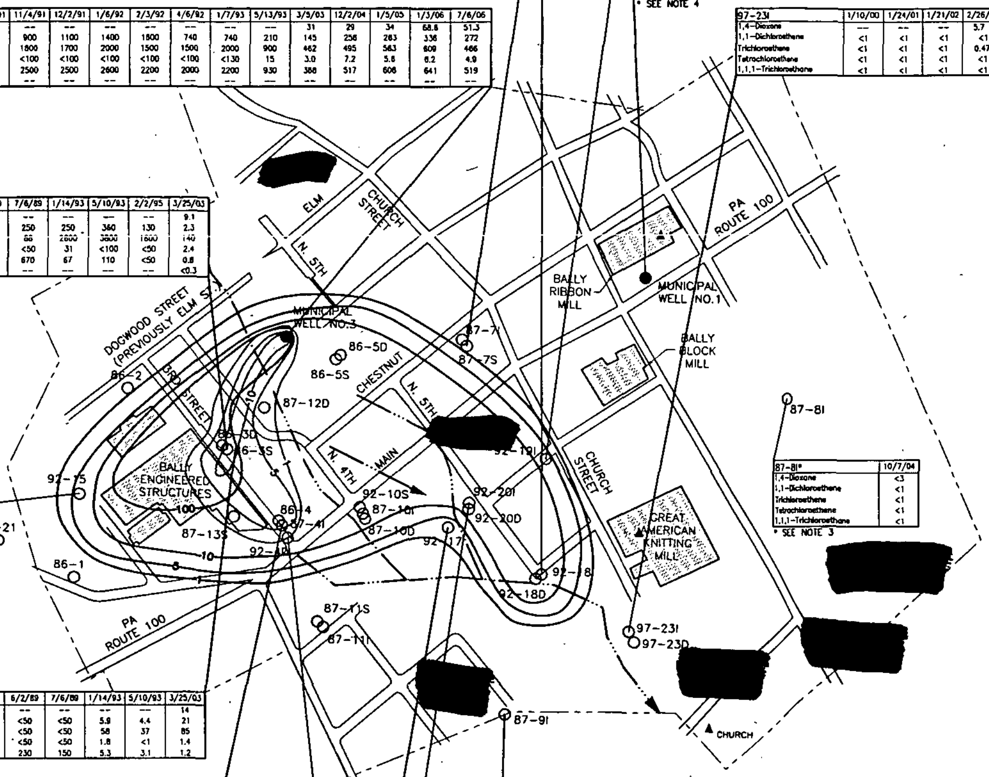
86-03D	5/12/86*	1/9/88*	1/31/89	3/1/89	3/14/89	4/5/89	5/5/89	6/2/89	7/6/89	1/14/93	5/10/93	2/2/95	3/25/03
1,4-Dioxane 2	--	--	--	--	--	--	--	--	--	--	--	--	9.1
Dichloroethene, 1,1-	130	180	59	450	340	310	720	270	250	250	1400	130	2.3
Trichloroethene	50	ND	<1	52	62	36	640	<50	66	2600	3500	1600	140
Tetrachloroethene	ND	ND	<1	<1	1	<10	<25	<50	<50	31	<100	<50	2.4
Trichloroethane, 1,1,1-	210	180	83	1000	510	670	1900	390	670	67	110	<50	0.8
Dichloroethene, cis-1,2-	--	--	--	--	--	--	--	--	--	--	--	--	<0.3

* SEE NOTE 4

92-15	2/25/93	5/13/93	2/2/95	3/25/03
1,4-Dioxane	--	--	--	<0.7
1,1-Dichloroethene	11	4.9	4.7	1.8
Trichloroethene	22	13	14	4.3
Tetrachloroethene	<1	<1	<1	<0.2
1,1,1-Trichloroethane	34	20	17	3.4

94-21	2005*
TVOC	<1

* SEE NOTE 5



86-03S	5/13/86*	1/9/88*	1/31/89	3/1/89	3/14/89	4/5/89	5/5/89	6/2/89	7/6/89	1/14/93	5/10/93	3/25/03
1,4-Dioxane	--	--	--	--	--	--	--	--	--	--	--	14
Dichloroethene, 1,1-	170	280	340	230	75	140	110	<50	<50	5.9	4.4	21
Trichloroethene	4	ND	<10	<50	<50	<50	3	<50	<50	58	37	85
Tetrachloroethene	ND	ND	<10	<50	<50	<50	<1	<50	<50	1.8	<1	1.4
Trichloroethane, 1,1,1-	1300	1000	2100	850	250	680	430	230	150	5.3	3.1	1.2

* SEE NOTE 4

86-04I	1/9/88	1/31/89	3/1/89	3/14/89	4/5/89	5/5/89	6/2/89	7/6/89	2/25/93	5/12/93	3/25/03
1,4-Dioxane	--	--	--	--	--	--	--	--	--	--	7.4
Dichloroethene, 1,1-	290	93	120	110	110	660	560	<200	<60	48	2.7
Trichloroethene	3100	1600	1300	1100	1300	5800	5400	4900	570	680	24
Tetrachloroethene	--	<10	<25	<25	<25	<50	<50	<200	<100	11	0.4
Trichloroethane, 1,1,1-	470	<10	<25	40	83	1200	400	<200	<100	45	1.1
Dichloroethene, cis-1,2-	--	--	--	--	--	--	--	--	--	--	<0.3

92-04D	1/28/93	2/26/93	5/13/93	2/2/95	3/25/03	3/25/03
1,4-Dioxane	--	--	--	--	<0.4	<0.4
Dichloroethene, 1,1-	67	16	0.8	<5	1.2	1.2
Trichloroethene	500	170	60	44	12	9.2
Tetrachloroethene	<10	<1	<1	<5	<0.2	<0.2
Trichloroethane, 1,1,1-	87	22	12	5.6	1.8	<0.3

87-9I	1/9/88*	1/20/93	5/13/93	3/25/03
1,4-Dioxane	--	--	--	<0.4
1,1-Dichloroethene	ND	<1	<1	<0.3
Trichloroethene	ND	<1	<1	0.2
Tetrachloroethene	--	<1	<1	<0.2
1,1,1-Trichloroethane	ND	<1	<1	<0.3

* SEE NOTE 4

87-8I*	10/7/04
1,4-Dioxane	<3
1,1-Dichloroethene	<1
Trichloroethene	<1
Tetrachloroethene	<1
1,1,1-Trichloroethane	<1

* SEE NOTE 3

92-17	6/7/99	1/10/00	7/24/00	1/24/01	8/6/01	1/21/02	7/9/02	9/12/02	2/26/03	3/25/03	3/25/03 D	10/14/03	3/16/04	10/6/04	3/28/05	9/20/05	3/7/06
1,4-Dioxane	--	--	--	--	--	--	--	--	<10	<0.4	<0.4	<5	1.8 J	<5	<2.8	<2.9	<2.8
1,1-Dichloroethene	10	40	6.0	14	20	5.91	188	24	4.4	0.5	0.4	1.8	18	2.4	1.7	4.3	1.7
Trichloroethene	14	50	7.0	21	34.8	8.75	60	60.6	9.7	0.4	0.1	4.8	30	3.9	3.1	8.5	2.6
Tetrachloroethene	<1	<1	<1	<1	--	<1	1.35	<1	<1	<0.2	<0.2	<0.60	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	7.0	24	2.0	8.0	<5	4.27	32	10.8	1.2	<0.3	<0.3	0.72	5.8	0.59 J	0.45 J	1.5	<1

92-20I	6/7/99	1/10/00	7/24/00	1/24/01	8/6/01	1/21/02	7/9/02	9/12/02	2/27/03	10/14/03	3/16/04	10/7/04	3/28/05	9/20/05	3/7/06
1,4-Dioxane	--	--	--	--	--	--	--	--	<10	<5	<3	<3	<2.8	<2.8	<2.8
1,1-Dichloroethene	8.0	11	8.0	6.0	7.47	--	49.1	16.9	2.5	6.0	10	6.3	4.6	5.8	<1
Trichloroethene	10	15	11	8.0	11.2	8.05	35.9	40.8	6.2	9.3	14	8.3	6.4	9.2	7.8
Tetrachloroethene	<1	<1	<1	<1	--	--	<1	<1	<1	<0.60	<1	<1	<1	<1	<1
1,1,1-Trichloroethane	8.0	11	4.0	5.0	<5	<2	19.2	8.31	2.0	4.1	4.8	4.5	3.6	4.0	3.5

0 500 SCALE: 1"=500'

LEGEND

- EXISTING MONITORING WELLS
- PRIVATE OR INDUSTRIAL WELL
- EXISTING MUNICIPAL WELL
- PROPERTY BOUNDARY
- STREAM
- GROUNDWATER FLOW DIRECTION
- —100— TOTAL VOC 100 ug/L ISOPLETH, BASED ON MOST RECENT DATA (2003-2006)
- —10— TOTAL VOC 10 ug/L ISOPLETH, BASED ON MOST RECENT DATA (2003-2006)
- —5— TOTAL VOC 5 ug/L ISOPLETH, BASED ON MOST RECENT DATA (2003-2006)
- —1— TOTAL VOC 1 ug/L ISOPLETH, BASED ON MOST RECENT DATA (2003-2006)
- 10: 1,4-DIOXANE >10 ug/L, BASED ON MOST RECENT DATA (2003-2006)
- 5: 1,4-DIOXANE >5 ug/L, BASED ON MOST RECENT DATA (2003-2006)
- 1: 1,4-DIOXANE >1 ug/L, BASED ON MOST RECENT DATA (2003-2006)

WELL ID — SAMPLE DATE

87-8I	10/7/04
1,4-Dioxane	<3
1,1-Dichloroethene	<1
Trichloroethene	<1
Tetrachloroethene	<1 J
1,1,1-Trichloroethane	<1

CONSTITUENT — ESTIMATED VALUE — CONCENTRATION (MICROGRAMS PER LITER (ug/L))

EPA MCL STANDARDS (ug/L)	
1,4 Dioxane	3*
1,1-Dichloroethene	7
Trichloroethene	5
Tetrachloroethene	5
1,1,1-Trichloroethane	200

* NO MCL EXISTS PRESENTLY FOR 1,4-DIOXANE. THE 3 ug/L VALUE IS PROPOSED BY EPA.

NOTES:

1. ALL CONCENTRATIONS IN ug/L
2. D: DUPLICATE
3. WELL 87-8I WAS SAMPLED DURING THE OCTOBER 2004 EVENT TO REEVALUATE THE NORTHEASTERN LIMIT OF THE PLUME.
4. NO DETECTION LIMITS AVAILABLE FOR 1982, 1986, AND 1988 DATA.
5. BASED ON 1996 SOUTHERN AREA MONITORING REPORT BY CEC.

Area Manager	M. BEDARD
Project Director	M. WOLFERT
Task Manager	C. SHARPE
Technical Review	

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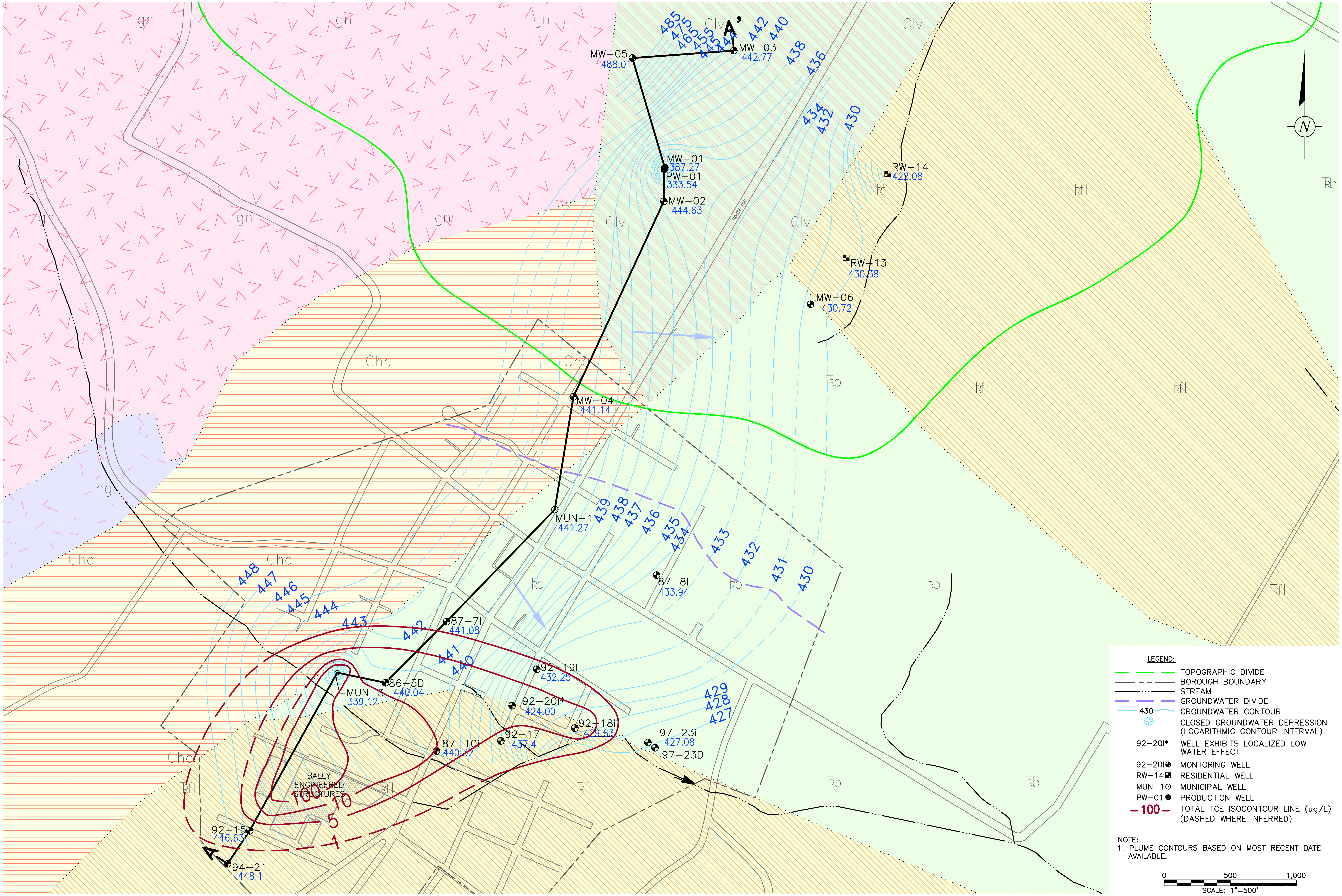
SUNBEAM PRODUCTS INC.
BALLY FOCUSED FEASIBILITY STUDY

SELECTED GROUNDWATER SAMPLING RESULTS 1982 TO JULY 2006 AND EXTENT OF 1,4-DIOXANE IN GROUNDWATER

BALLY, PA

Project Number: NP000597.0002
Date: 28 AUGUST, 2006
Figure: 3

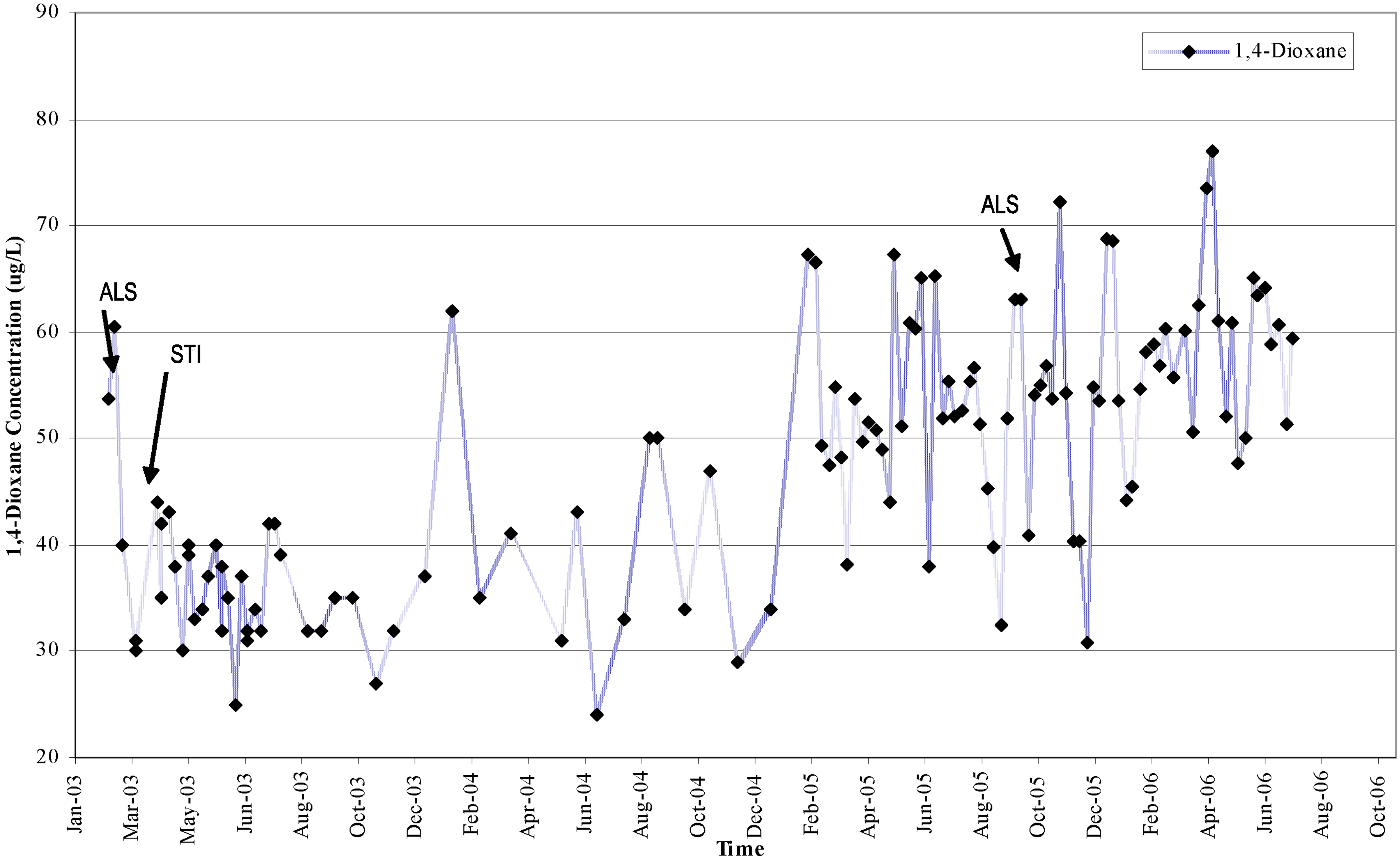


Area Manager: A. ROBINSON	ARCADIS	Project Number: NP000597.002
Project Director: M. WOLFERT	6 Terry Drive, Suite 300, Newtown, Pa 18940, Tel: 267/685-1800 Fax: 267/685-1801, www.arcadis-us.com	Date: 5 JULY 06
Task Manager: C. SHARPE		Figure: 4
Technical Review: S. POTTER		

SUNBEAM PRODUCTS INC.
BALLY WATER RESOURCES INVESTIGATION

GROUNDWATER FLOW AND TCE ISOCONTOURS NEAR END OF FINAL PUMPING TEST - DECEMBER 12, 2005

BALLY, PA



NOTE: ALS = DATA FROM ANALYTICAL LABORATORY SERVICES, INC.;
STL = DATA FROM SEVERN TRENT LABORATORY, INC.

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Acad Version: 16.1s (LMS Tech) User Name: Slattery, Carol

Department Manager	M. BEDARD
Project Director	M. WOLFERT
Technical Review	C. SHARPE
Checked	

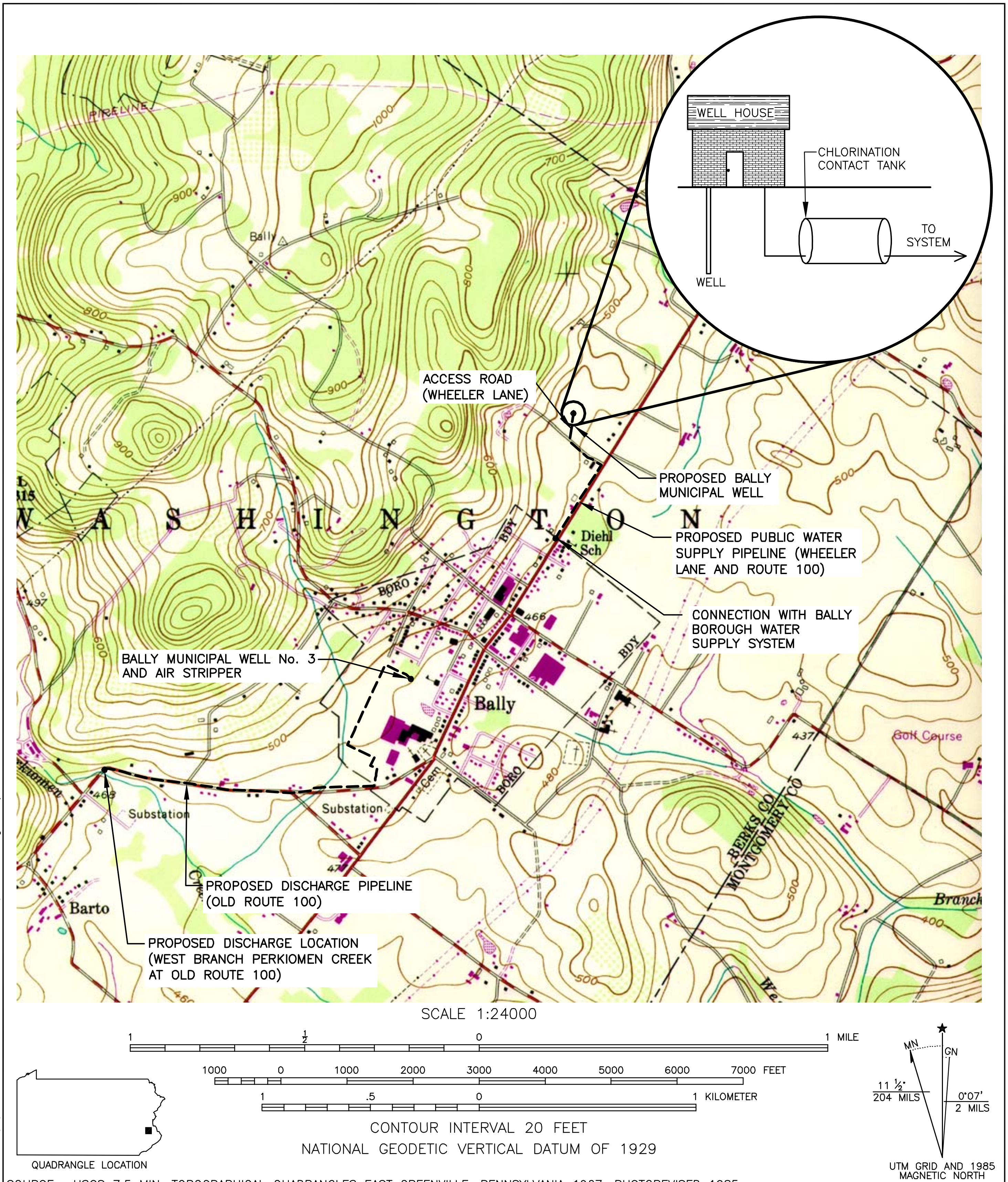
ARCADIS
6 Terry Drive
Suite 300
Newtown, Pa 18940
Tel: 267/685-1800 Fax: 267/685-1801

SUNBEAM PRODUCTS INC.
BALLY FOCUSED FEASIBILITY STUDY

1,4-DIOXANE CONCENTRATIONS, WELL NO. 3

BALLY, PA

Project Number	NP000597.0002
Drawing Date	28 AUGUST, 2006
Figure	5



SOURCE: USGS 7.5 MIN. TOPOGRAPHICAL QUADRANGLES EAST GREENVILLE, PENNSYLVANIA 1967, PHOTOREVISED 1985.

Department Manager M. BEDARD	ARCADIS	SUNBEAM PRODUCTS INC. BALLY FOCUSED FEASIBILITY STUDY	Project Number NP000597.0002
Project Director M. WOLFERT			Drawing Date 28 AUGUST, 2006
Technical Review C. SHARPE	6 Terry Drive Suite 300 Newtown, Pa 18940 Tel: 267/685-1800 Fax: 267/685-1801	SITE LOCATION MAP	Figure 6
Checked		BALLY, PA	

Path\Name: G:\APROJECT\AH Bally, PA\CADD\Focused Feasibility Study\FIG-06 ALTERNATIVE COMPONENENTS AND INFRASTRUCTURE.dwg
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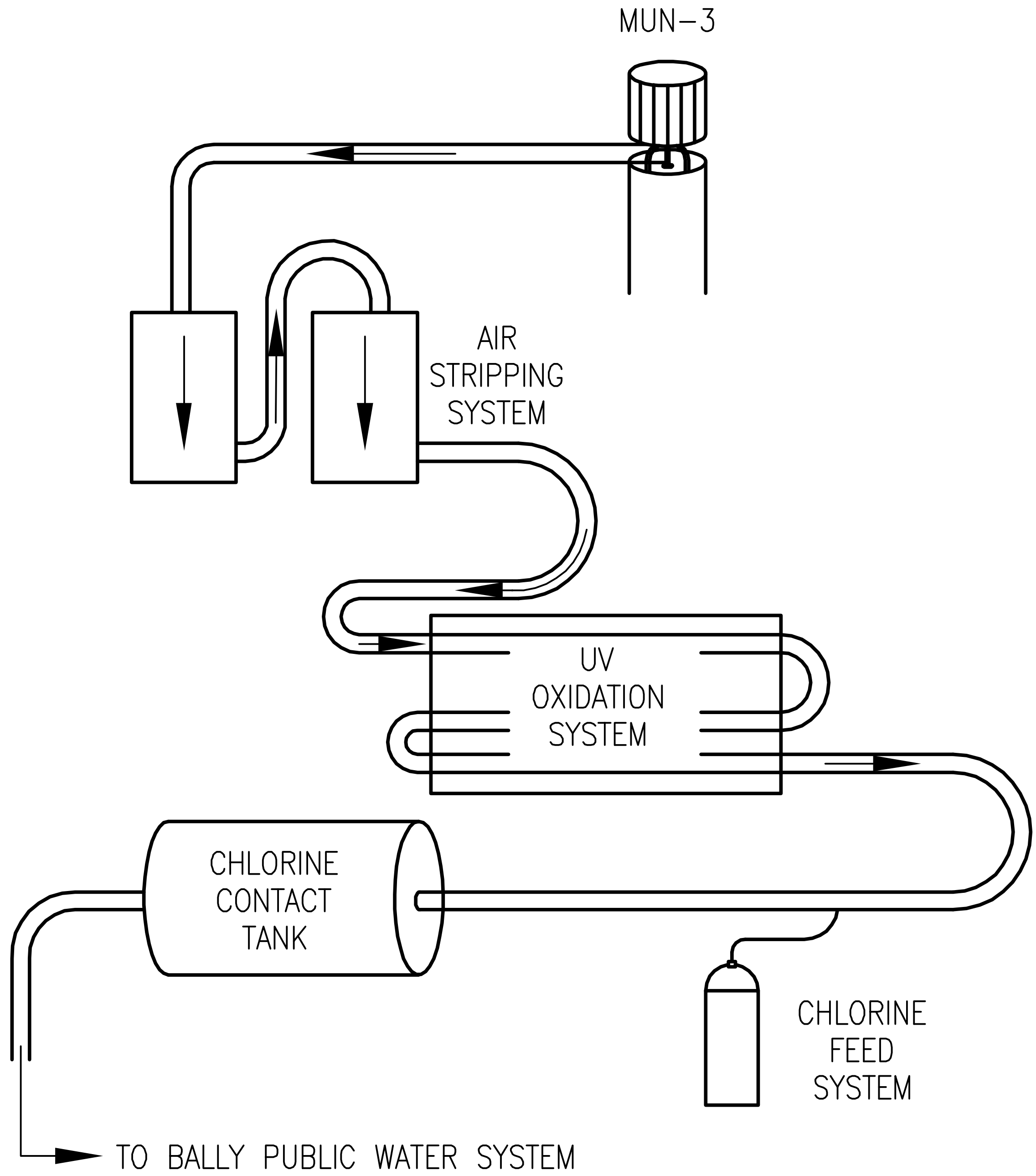
AR301235



Area Manager	R. GAN
Project Director	M. BEDARD
Task Manager	C. SHARPE
Technical Review	

ARCADIS
6 Terry Drive
Suite 300
Newtown, Pa 18940
Tel: 267/685-1800 Fax: 267/685-1801

SUNBEAM PRODUCTS INC.
FORMER BALLY ENGINEERED STRUCTURES

ALTERNATIVE 2 PROPOSED A.O.P. TREATMENT FLOW SCHEMATIC DIAGRAM

BALLY, PA

Project Number	NP000597.0002.00014
Drawing Date	27 SEPTEMBER, 2006
Figure	7

Date\Time : Mon, 12 Feb 2007 – 2:19pm
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User Name : cslattery

Appendix A

Existing Site ARARS for VOCs

Table A1 ARARs Established for VOCs in 1989 ROD Bally Groundwater Contamination Site Municipal Water Supply, Bally, Pennsylvania

Volatile Organic Compound (VOC)	CASRN #	ARAR [1]
1,1-Dichloroethene	75-35-4	7
Methylene Chloride	75-09-2	5 [2]
Tetrachloroethene	127-18-4	5
1,1,1-Trichloroethane	71-55-6	200
Trichloroethene	79-01-6	5

Notes:

[1] Based on MCLs established by PADEP (formerly PADER) unless otherwise noted

[2] Based on Risk Specific Dose

Appendix B

Bog Turtle Survey Reports and Concurrences

AMY S. GREENE
ENVIRONMENTAL CONSULTANTS, INC.

4 WALTER E. FORAN BOULEVARD, SUITE 209
FLEMINGTON, NJ 08822

(908) 788-9676 FAX (908) 788-6788 PA (610) 250-0773
E-MAIL mail@amygreene.com

Phase I Bog Turtle Habitat Survey

for the

Proposed Groundwater Treatment System Discharge Pipeline Route

Bally Borough

Berks County, Pennsylvania

November 2004

Prepared For:

Arcadis G&M, Inc.
6 Terry Drive, Suite 300
Newtown, Pennsylvania, 18940

Prepared By:

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.
4 Walter E. Foran Boulevard
Flemington, New Jersey 08822
ASGECI Project #2419

AMY S. GREENE
ENVIRONMENTAL CONSULTANTS, INC.

4 WALTER E. FORAN BOULEVARD, SUITE 209
FLEMINGTON, NJ 08822

(908) 788-9676 FAX (908) 788-6788 PA (610) 250-0773
E-MAIL mail@amygreene.com

November 5, 2004

Arcadis G&M, Inc.
6 Terry Drive, Suite 300
Newtown, Pennsylvania, 18940
Attn: [redacted]

VIA OVERNIGHT MAIL (Airborne Express)

RE: Proposed Groundwater Treatment System
Discharge Pipeline Route
Phase I Bog Turtle Habitat Survey
Bally Borough
Berks County, Pennsylvania
ASGECI Project #2419

Dear [redacted]

Amy S. Greene Environmental Consultants, Inc. (ASGECI) performed a Phase I Bog Turtle Habitat Survey for the proposed Groundwater Treatment System Discharge Pipeline Route in the Borough of Bally, Berks County, Pennsylvania on September 8 and 10, 2004. Three wetland crossings were investigated for potential habitat for bog turtle. The habitat survey was conducted by Mr. Scott Angus, a US Fish and Wildlife Service (USFWS) Recognized Qualified Bog Turtle Surveyor in accordance with methodologies outlined in the USFWS's "Bog Turtle (*Glyptemys {Clemmys} muhlenbergii*) Northern Population Recovery Plan (May 2001)."

Purpose of Study

The bog turtle's northern population has been listed as threatened by the USFWS pursuant to Section 7 of the Endangered Species Act of 1973. USFWS guidelines require that surveys for bog turtle habitat (Phase I Bog Turtle Habitat Survey) be performed to determine if potential bog turtle habitat occurs in the vicinity of or within a proposed project's limits, in a region where bog turtle habitat is known to be present. If potential bog turtle habitat is present then the USFWS may require a visual bog turtle survey (Phase II Bog Turtle Survey).

Bog Turtle Range and Habitat

Bog turtles occur discontinuously in western, central and southern New York, adjacent Connecticut and Massachusetts, New Jersey, Pennsylvania, northern Delaware and Maryland, southwestern Virginia, and western North Carolina (Conant, 1975). In Pennsylvania, bog turtle populations may occur in Adams, Berks, Bucks, Chester, Cumberland, Delaware, Franklin, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, southern Schuylkill and York Counties.

Habitat for bog turtle includes sunlit, marshy meadows, spring seeps, bogs, and fens, usually with shallow slow-moving water (Conant 1975; Behler and King 1997). Vegetation can include cattails (*Typha latifolia, T. angustifolia*), tussock sedge (*Carex stricta)*, other sedge species *(Carex spp*., *Cyperus spp*., *Dulichium sp*.), rushes (*Juncus spp*.), bulrushes (*Scirpus spp*.), spikerushes (*Eleocharis spp*.), spotted jewelweed (*Impatiens capensis*), alders (*Alnus spp*.), skunk cabbage (*Symplocarpus foetidus*), arrow-leaved tearthumb (*Polygonum sagittatum*), rice cut-grass (*Leersia oryzoides*), and other open canopy wetland species (Cromartie, et al. 1982). Other elements listed in habitat descriptions include soft mucky substrates for burrowing and hibernation; an interspersal of wet and dry areas within sites, often with the presence of muskrat and meadow vole runways for travel corridors and cryptic basking sites; a mosaic of habitats present such as uplands, shallow water and muck, and deeper water; and a predominantly open canopy, with scattered areas of shrubs and small trees (U.S. Fish and Wildlife Service 1997).

Site Description

The proposed project is planned within the boundary of Bally Borough, Berks County, Pennsylvania (USGS Map - Figure 1). Three wetland areas are in the vicinity of the discharge pipeline route. The Phase I survey was performed on each wetland to determine if bog turtle habitat is present and if bog turtle habitat is present, the best route through the wetland areas to avoid impacts to any habitat present. To simplify the process each wetland is numbered and descriptions are provided below.

Wetland #1

Wetland #1 is located within the Borough Park. The discharge pipe will originate at a well and flow southwest through a mowed lawn within the park. The discharge pipe is proposed to cross an unnamed tributary to the Upper Perkiomen Creek with an emergent wetland fringe found within the park. The emergent wetland fringe associated with the tributary is mowed within the park boundaries. The tributary continues to flow downstream through the maintained park grounds to a culvert that flows under Route 100. Upstream of the crossing, the Township does not maintain the emergent wetland. Approximately 600 feet upstream from the crossing a housing development is in the process of being constructed. The tributary and the associated wetland fringe flows within 100 feet of the development. Portions of the tributary have been rip-rapped and fibrous erosion control material is evident within the wetland fringe. From this point the tributary flows toward the crossing. The wetland fringe continues to be generally emergent with a few shrubs and trees mixing into the community and eventually flows to the maintained park setting again near the proposed wetland crossing.

Wetland #2

Wetland #2 is located on Old Route 100 outside of the developed portion of Bally Borough. An unnamed tributary to the Upper Perkiomen Creek flows north to south through a pipe under Old Route 100. The proposed pipeline will cross the wetland within the existing right-of-way on the south (downstream) side of Old Route 100. The wetland community on the south side of Route 100 consists of forested fringe with a few scrub/shrub and emergent components as well. The wetland community associated with the tributary continues out of the project area and eventually flows under Dairy Lane.

The wetland community on the north (upstream) side of Old Route 100 is generally a scrub/shrub fringe associated with the unnamed tributary to the Upper Perkiomen Creek. Continuing upstream and up gradient of Old Route 100, the wetland community becomes more extensive and emergent and groundwater seepages appear to feed the tributary in some areas.

Wetland #3

Wetland #3 is located on Old Route 100 outside of the developed portion of Bally Borough. The wetland communities associated with wetland #3 are directly adjacent to and include the Upper Perkiomen Creek. The discharge pipe is proposed to be constructed within the existing right-of-way of Old Route 100, and discharge in the vicinity of the Old Route 100 Bridge over the Upper Perkiomen Creek. The wetland communities identified within this portion of the project are generally forested. Small portions of the wetlands exhibit emergent wetland characteristics. The area closest to the point that the pipe will be discharging to the Upper Perkiomen Creek near the bridge should be classified as Waters of the US due to the absence of wetland vegetation along the banks of the creek.

<u>Survey Methodology</u>

Analysis of aerial photography, county soil surveys, USGS topographic quadrangles, USFWS National Wetlands Inventory mapping, and performance of a visual field survey were used to survey for potential bog turtle habitat.

<u>Discussion and Conclusion</u>

ASGECI investigated the entire proposed alignment of the Proposed Groundwater Treatment System Discharge Pipeline Route in Bally Borough, Berks County, Pennsylvania for the presence of potential bog turtle habitat. A periphery visual inspection of adjacent properties for potential bog turtle habitats was conducted as well. Each wetland encountered was evaluated and the results are as follows:

- **Wetland #1** – An unnamed tributary to the Upper Perkiomen Creek meanders through Bally Borough Park, and exhibits an emergent and scrub/shrub wetland fringe. A large portion of the emergent wetland was mowed and is park-like in appearance. Identifiable vegetation in the mowed, emergent wetland fringe was generally yellow-fruited sedge, soft rush, Kentucky bluegrass, and moneywort.

Upstream, an existing housing development under construction has appears to have impacted the wetlands. Vegetation identified in this portion of the site included spotted jewelweed, begger-ticks, arrow-leaved tearthumb and woolgrass. The substrates identified within the wetland fringes of the tributary were generally solid or dense from clay content and not consistent with substrates generally found within bog turtle habitats.

Wetland #1 does not exhibit the characteristics consistent with known bog turtle habitats. It appears a wetland crossing in this area will not impact wetlands associated with bog turtle habitats.

- **Wetland #2** - An unnamed tributary to the Upper Perkiomen Creek flows north to south and is piped under Old Route 100. The proposed discharge pipe will cross the wetland within the right-of-way of Old Route 100 on the south side of the road. On the south (downstream) side of the road the tributary exhibits a wetland fringe dominated by red maple, ash-leaved maple, multiflora rose, silky dogwood and southern arrowwood. The substrates were solid and there was no groundwater hydrology.

  On the north (upstream) side of Old Route 100 the tributary while in the right-of-way exhibits a scrub/shrub wetland fringe dominated by silky dogwood, sapling ash-leaved maples and spotted jewelweed. All of these plants are being out competed by Japanese honeysuckle and multiflora rose. Wetland #2 does not exhibit the characteristics consistent with known bog turtle habitats. It appears that there will be no direct or indirect impacts to bog habitats where the discharge pipe crosses Wetland #2.

  Upstream of the proposed "zone of construction" activities associated with the crossing of Wetland #2 the wetlands expand, are less channelized and are groundwater fed. The wetland community becomes emergent/scrub/shrub dominated by rice-cutgrass, reed-canary grass, arrow-leaved tearthumb, goldenrod sp., and silky dogwood. Substrates become muckier though there was no area found where the substrates were mucky enough to sink above the ankle to mid-shin. There is a possibility that deeper muck is within the thicker shrubby area where it was difficult to access. The hydrology was groundwater fed within the upstream portions of the wetland. It appears that the wetland upstream of the zone of construction maybe classified as potential bog turtle habitat. The potential habitat is nearly 500 feet upstream of the zone of construction so it does not appear that there would be any direct or indirect impacts to the potential bog turtle habitat. It is possible that a bog turtle that is utilizing the tributary as a travel corridor while construction activities are taking place could potentially be injured or killed. It appears that the USFWS will not require a Phase II Visual Survey for Bog Turtle for the project. It is probable that the USFWS will require construction monitoring for bog turtle during construction activities occurring within Wetland #2.

- **Wetland #3** – Wetland communities in the vicinity of construction activities for the discharge pipe are directly adjacent to the Upper Perkiomen Creek. The Groundwater Treatment System Discharge Pipeline Route is proposed to traverse the south side of Old Route 100 within the right-of-way. In the area of the bridge where Old Route 100 crosses the creek the pipeline is proposed to discharge the treated groundwater to the Upper Perkiomen Creek. The classification of the wetlands in this area would be Waters of the United States. Downstream of the bridge and associated Waters of the US, a forested freshwater seepage wetland drains from the north side of Old Route 100 through a pipe and into a contiguous forested wetland adjacent to the Upper Perkiomen Creek. The forested freshwater seepage wetland on the north side of Old Route 100 consists almost entirely as a closed canopy and is approximately 30 feet by 50 feet. The only opening in the canopy is from the roadway cut for Old Route 100. The vegetation dominant in the freshwater seepage is spotted jewelweed and watercress. Water feeding this wetland flows from the hillside via a copper pipe where local people fill water jugs. The wetland was impacted by foot traffic in the vicinity of the pipe. Sparce vegetation grows in the area of the pipe due to the foot traffic and boards placed in the wetland for walking. This wetland area, which is on the north side of Old Route 100, will not be impacted by the proposed pipeline due to the proposed route being in the right-of-way on the south side of the road. It is doubtful that such a small, closed canopy seepage wetland will be considered potential bog turtle habitat by the USFWS. After draining under Old Route 100 there are no similar wetland habitats and the drainage flows into the Upper Perkiomen Creek. A Phase II Visual Survey for Bog Turtle is not anticipated to be required for this wetland or this portion of the project. Except in the area of the freshwater seepage there are no mucky soils within the remainder of Wetland #3 and it is nearly entirely forested. As with Wetland #2, there is a potential that the USFWS may require construction monitoring for bog turtle during construction activities within Wetland #3, though most of the wetland is not suitable bog turtle habitat.

Other herptile species observed on site included green frogs, pickerel frog and garter snake.

If you have any questions regarding this investigation, please feel free to call me at (908) 788-9676 *(ext. 22)* or Tom Brodde of our staff *(ext. 15)*.

Sincerely,
AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.

[redacted]

USFWS Qualified Bog Turtle Surveyor

SA/tsb

cc: [redacted]

FIGURES

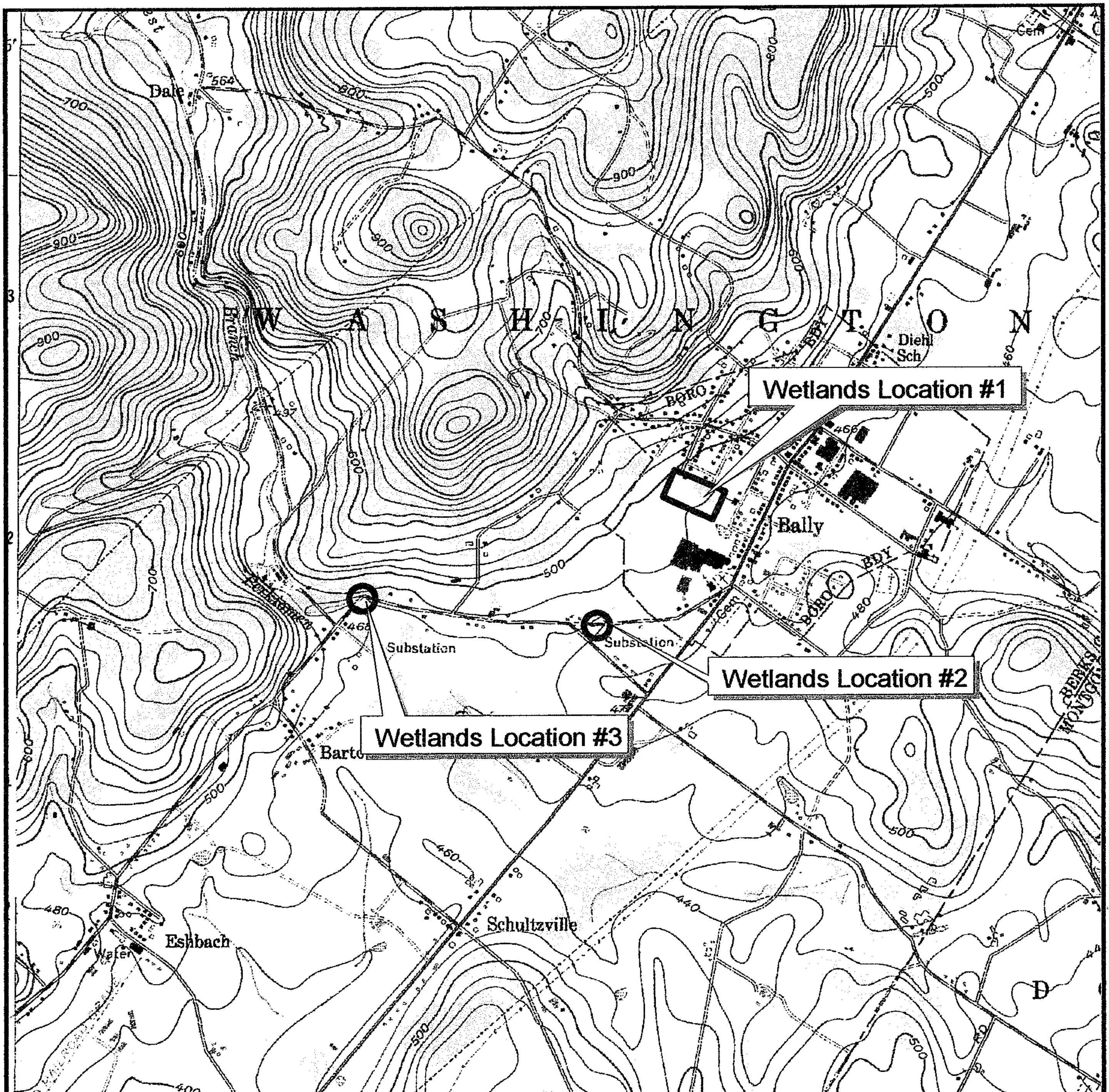

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FIGURE 1
USGS TOPOGRAPHIC MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.

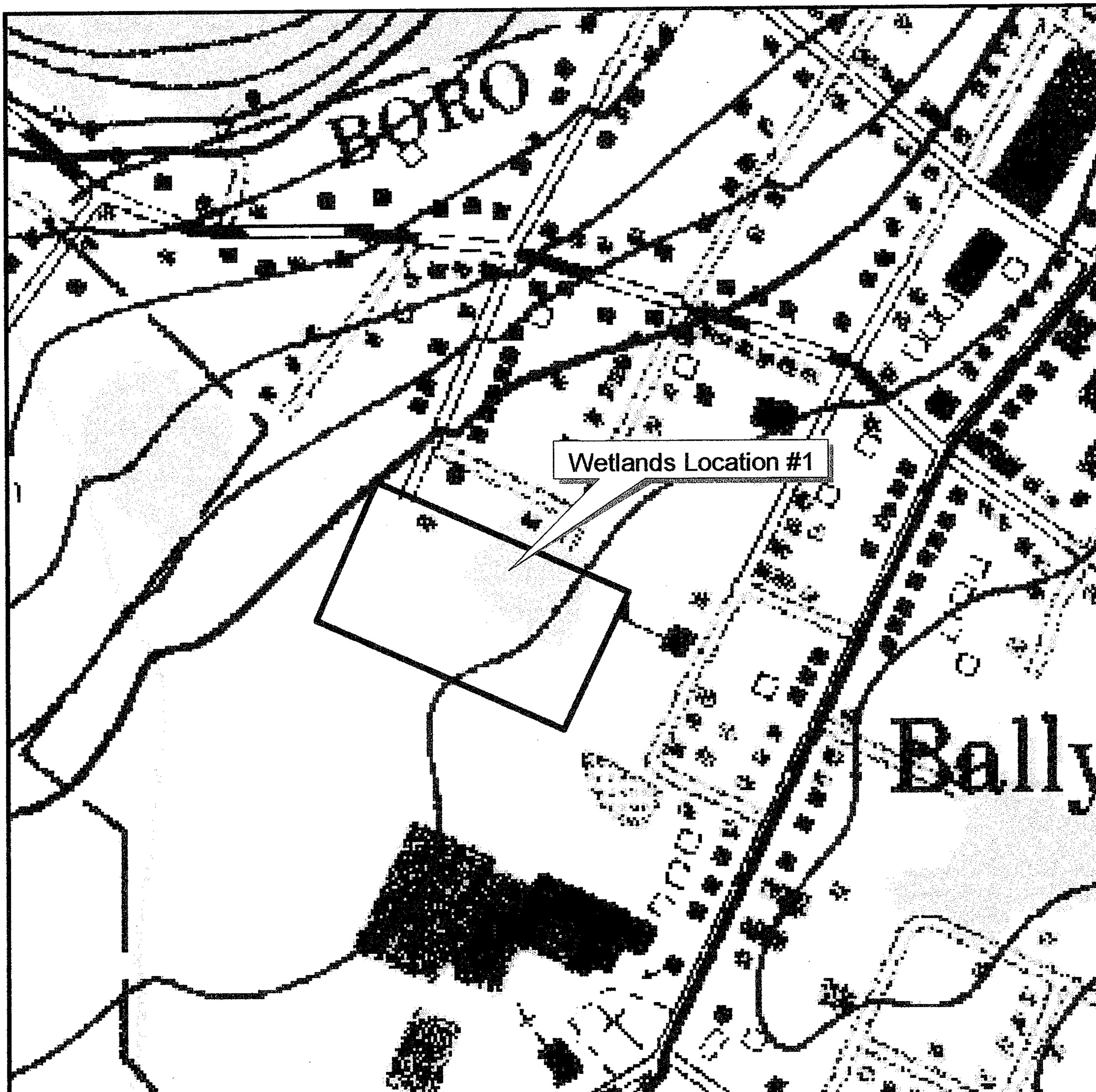

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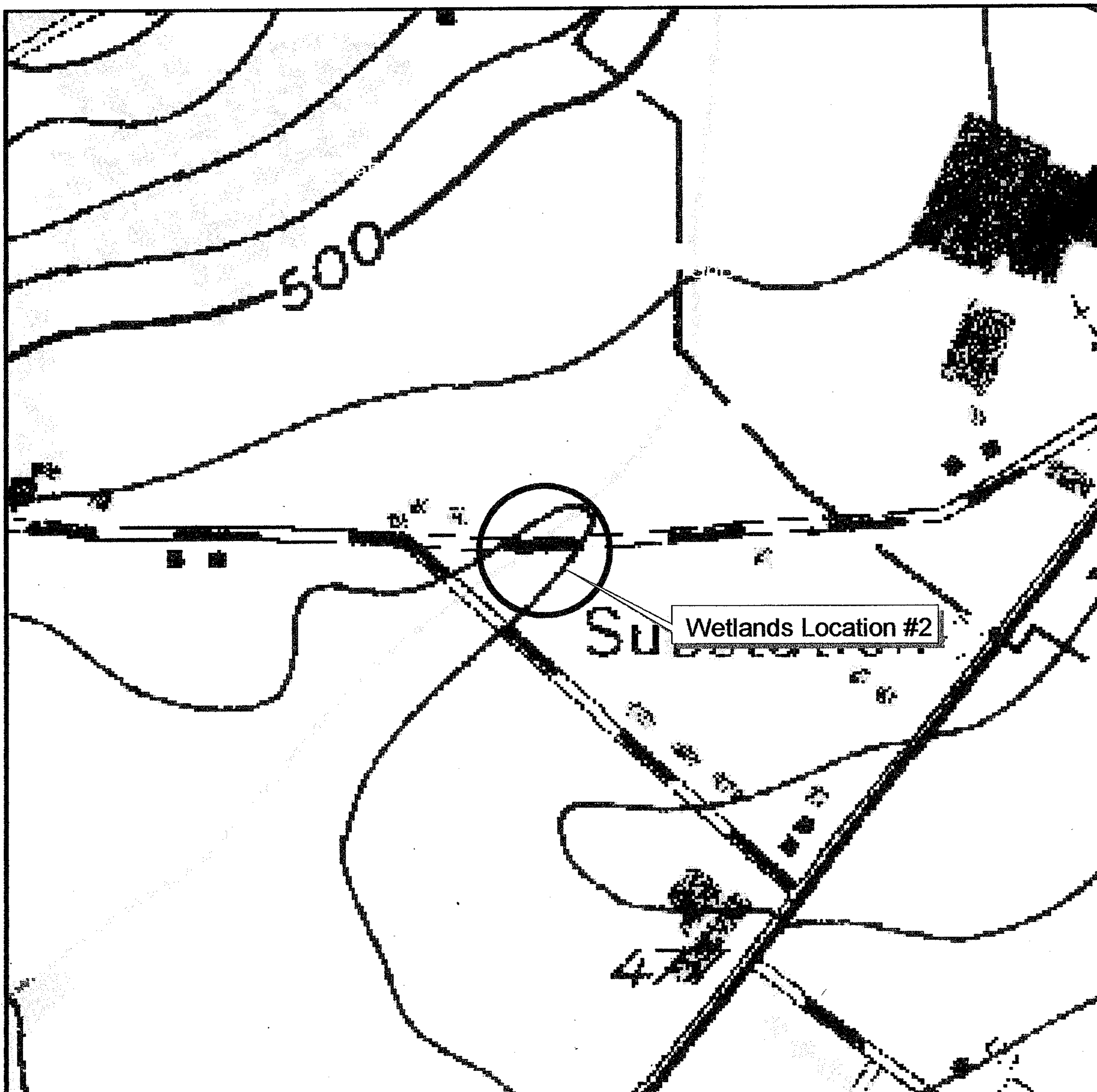
FIGURE 2
USGS TOPOGRAPHIC MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE
ENVIRONMENTAL CONSULTANTS, INC.



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SOURCE:
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0 400'

FIGURE 3
USGS TOPOGRAPHIC MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE
ENVIRONMENTAL CONSULTANTS, INC.

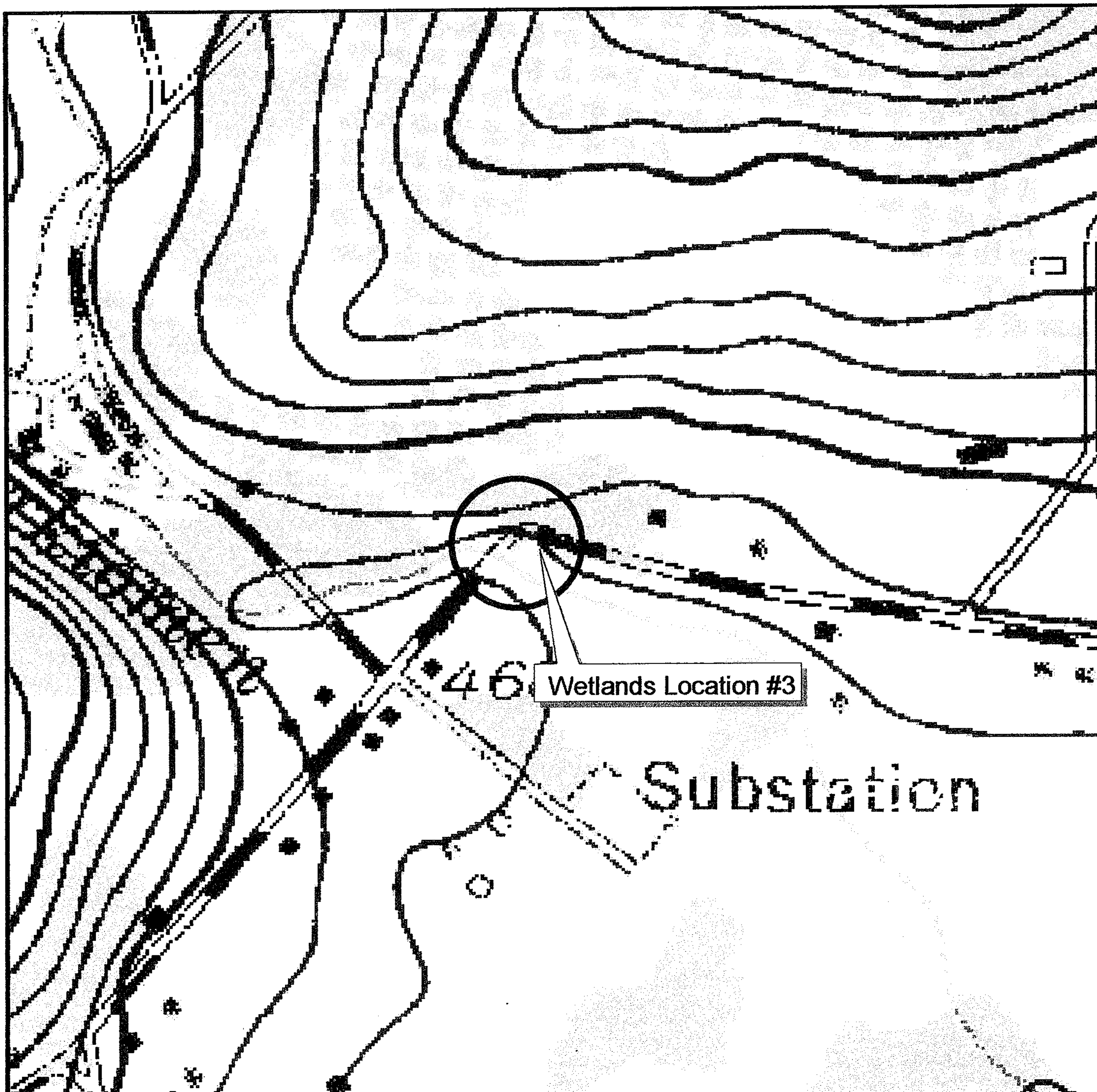

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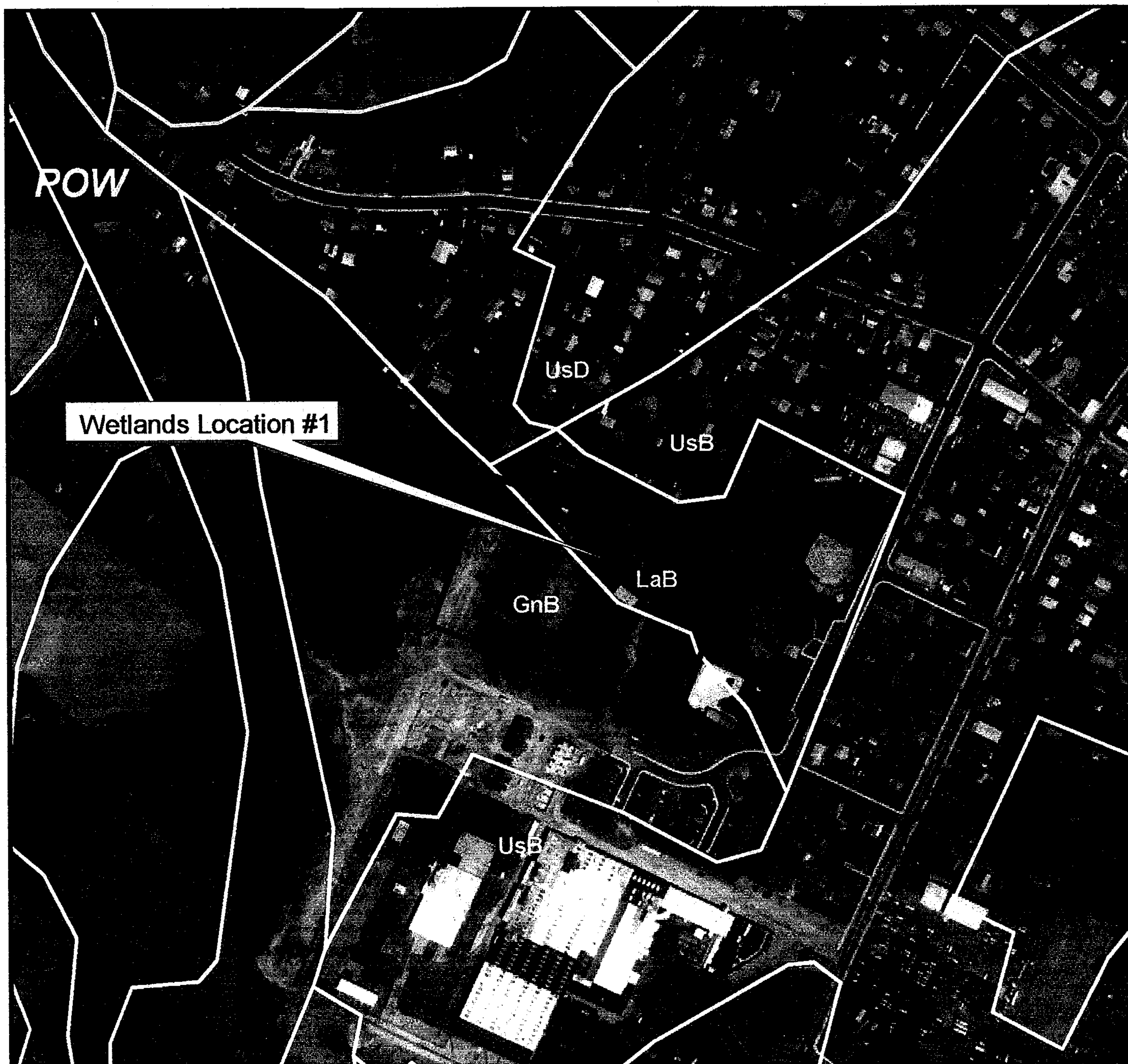
FIGURE 4
USGS TOPOGRAPHIC MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE
ENVIRONMENTAL CONSULTANTS, INC.



LEGEND:

NWI Classifications

POW - Palustrine Open Water Intermittently Permanent

Soil Descriptions

GnB - Glensville silt loam, 3 to 8% slopes
LaB - Laidig gravelly loam, 3 to 8% slopes
UsB - Urband Land, Laidig Complex, 0 to 8% slopes
UsD - Urban Lands, Laidig Complex, 8 to 25%

SOURCES:
National Wetlands Inventory Map,
Prepared by Office of Biological Services,
U.S. Department of the Interior, Fish and Wildlife Service, East Greenville, P.A. Quadrangle.

Soil Survey Geographic (SSURGO) Database
for Berks County, Pennsylvania, U.S.
Department of Agriculture, Natural Resourse Conservation Service, Fort Worth, Texas, May 1999.

Digital Orthophoto MrSID Moasaic for East Greenville, P.A. Quadrangle, U.S. Geologic Survey, Pennsylvania Bureau of Topographic and Geologic Survey, Reston, VA, 1997.

0 400'

FIGURE 5
NATIONAL WETLANDS INVENTORY AND SSURGO MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.

LEGEND:

NWI Classifications

POW - Palustrine Open Water Intermittently Permanent

R5OWH - Riverine Unknown Perennial Open Water Permanent

Soil Descriptions

AsC - Athol silt loam, 8 to 15%

GnB - Glensville silt loam, 3 to 8% slopes

Ho - Holly silt loam

LaB - Laidig gravelly loam, 3 to 8% slopes

ToA - Towhee silt loam, 0 to 3% slopes

SOURCES:
National Wetlands Inventory Map,
Prepared by Office of Biological Services,
U.S. Department of the Interior, Fish and Wildlife Service, East Greenville, P.A. Quadrangle.

Soil Survey Grographic (SSURGO) Database
for Berks County, Pennsylvania, U.S.
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Digital Orthophoto MrSID Moasaic for East Greenville, P.A. Quadrangle, U.S. Geologic
Survey, Pennsylvania Bureau of Topographic
and Geologic Survey, Reston, VA, 1997.

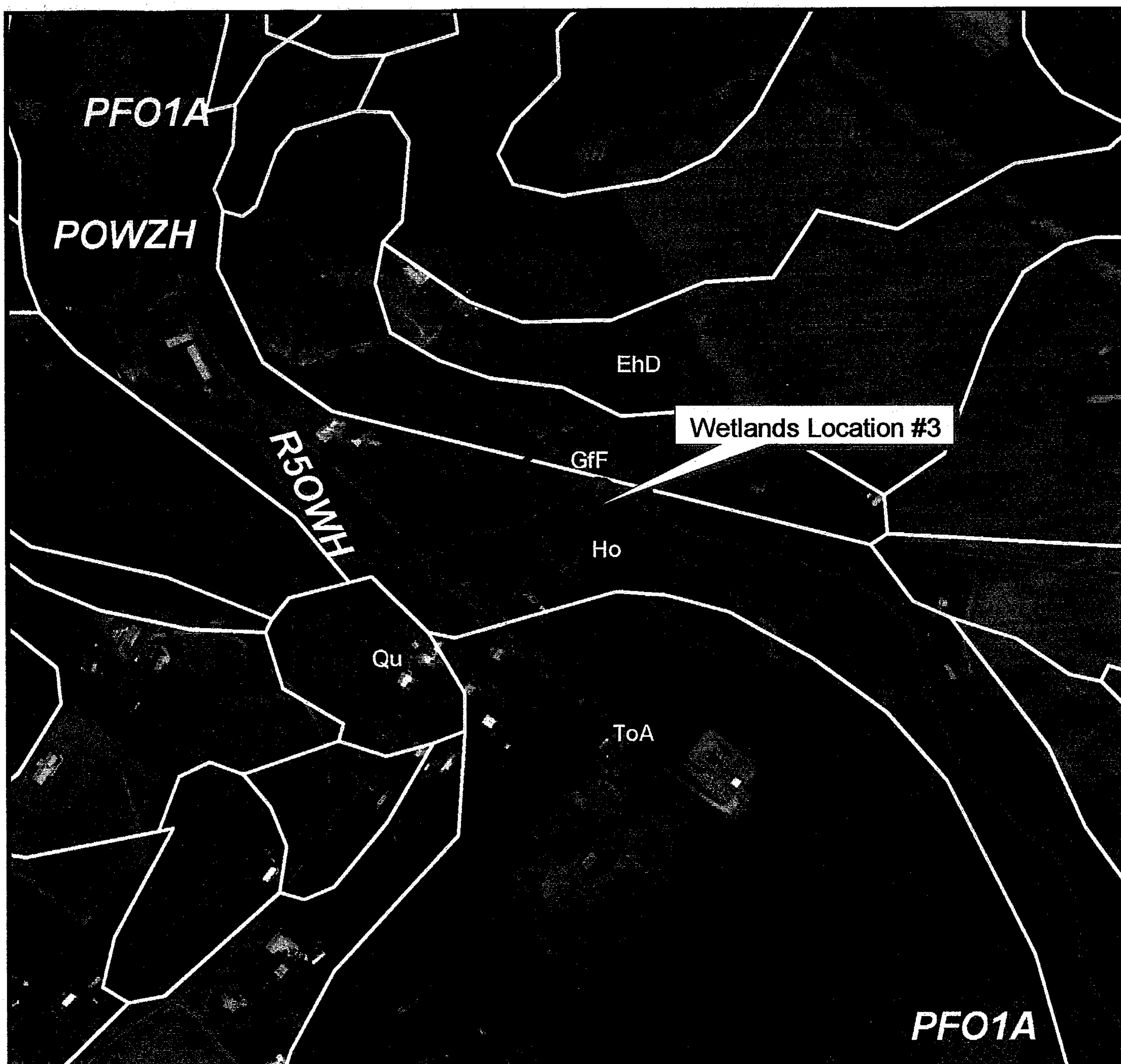
0 400'

FIGURE 6
NATIONAL WETLANDS INVENTORY AND SSURGO MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.



LEGEND:

NWI Classifications

- PFO1A - Palustrine Forested Broad Leaved Deciduous Temporary
- R5OWH - Riverine Unknown Perennial Open Water Permanent
- POWZH - Palustrine Open Water Intermittently Exposed Permanent

Soil Descriptions

- EhD - Edgemont channery loam, 15 to 25% slopes
- GfF - Gladstone gravelly silt loam, 25 to 55%
- Ho - Holly silt loam
- Qu - Quarries
- ToA - Towhee silt loam, 0 to 3% slopes

SOURCES:
National Wetlands Inventory Map,
Prepared by Office of Biological Services,
U.S. Department of the Interior, Fish and Wildlife Service, East Greenville, P.A. Quadrangle.

Soil Survey Grographic (SSURGO) Database
for Berks County, Pennsylvania, U.S.
Department of Agriculture, Natural Resourse Conservation Service, Fort Worth, Texas, May 1999.

Digital Orthophoto MrSID Moasaic for East Greenville, P.A. Quadrangle, U.S. Geologic
Survey, Pennsylvania Bureau of Topographic
and Geologic Survey, Reston, VA, 1997.

0 400'

FIGURE 7
NATIONAL WETLANDS INVENTORY AND SSURGO MAP

Phase I Bog Turtle Habitat Assesment
Bally Borough and Washington Township
Berks County, Pennsylvania

ASGECI Project #2419

AMY S. GREENE ENVIRONMENTAL CONSULTANTS, INC.

SITE PHOTOGRAPHS WITH DESCRIPTIONS

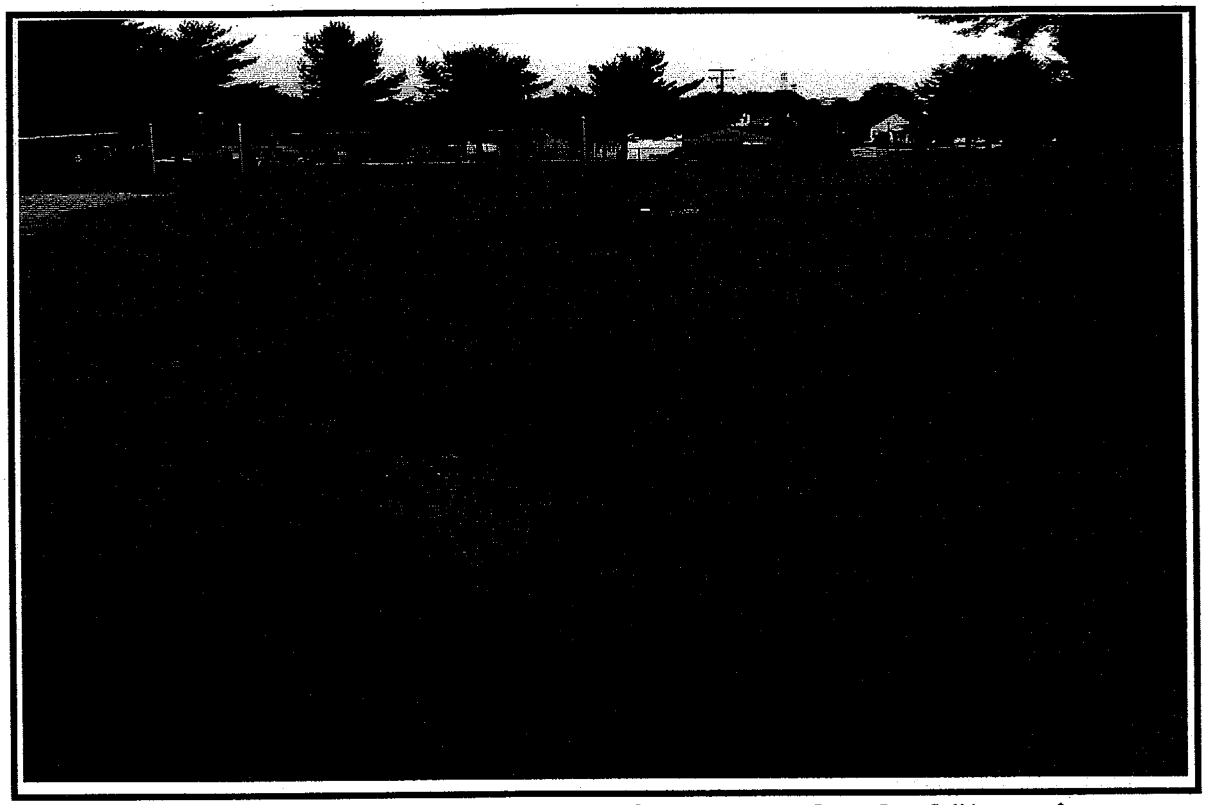


Photo A – This is the approximate location of the proposed wetland #1 crossing. Although there was emergent wetland vegetation, it was mowed short and the substrate was solid.

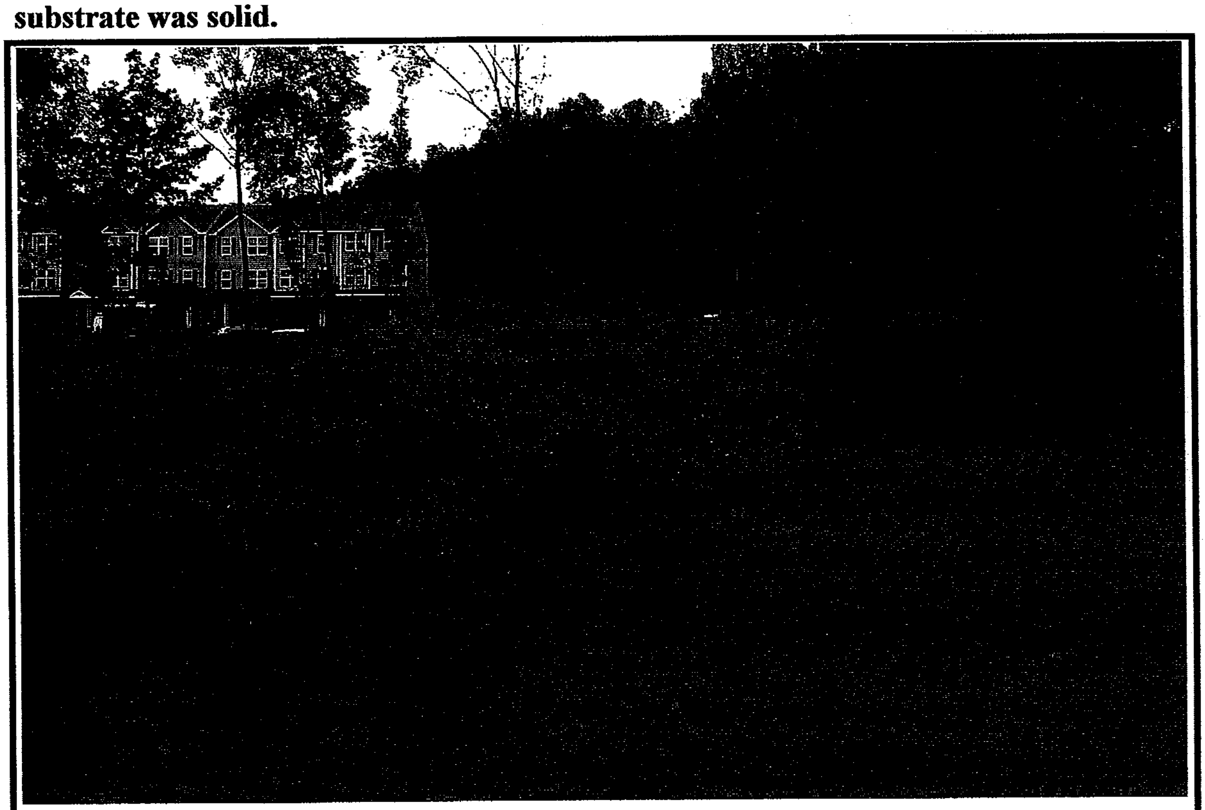


Photo B – Upstream from approximate wetland #1 crossing. The small emergent wetland depicted exhibited substrates inconsistent with known bog turtle sites.

Photo C – An emergent wetland identified approximately 700 feet upstream of the wetland #1 crossing, which appears to have been impacted by a development. It does not appear the wetland was suitable for bog turtle prior to construction.

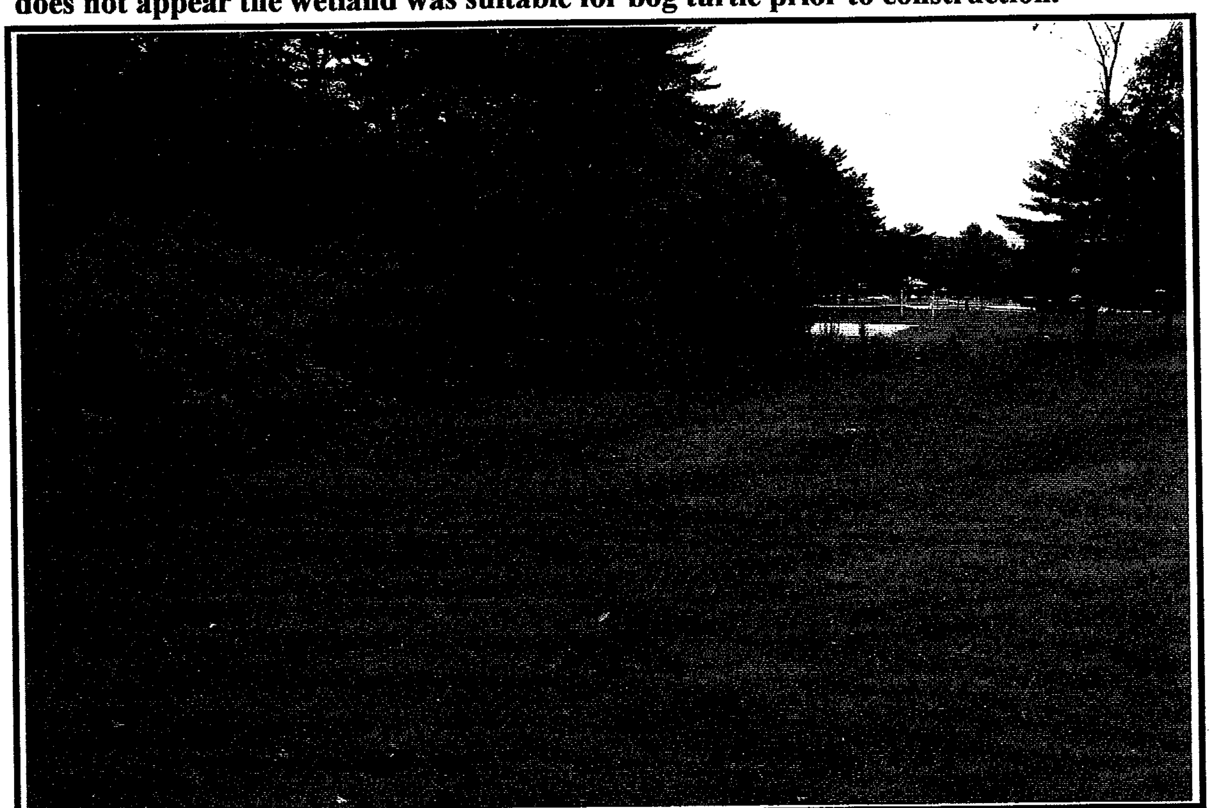


Photo D – Typical view of the upland fields found within the Borough park adjacent to wetland #1.

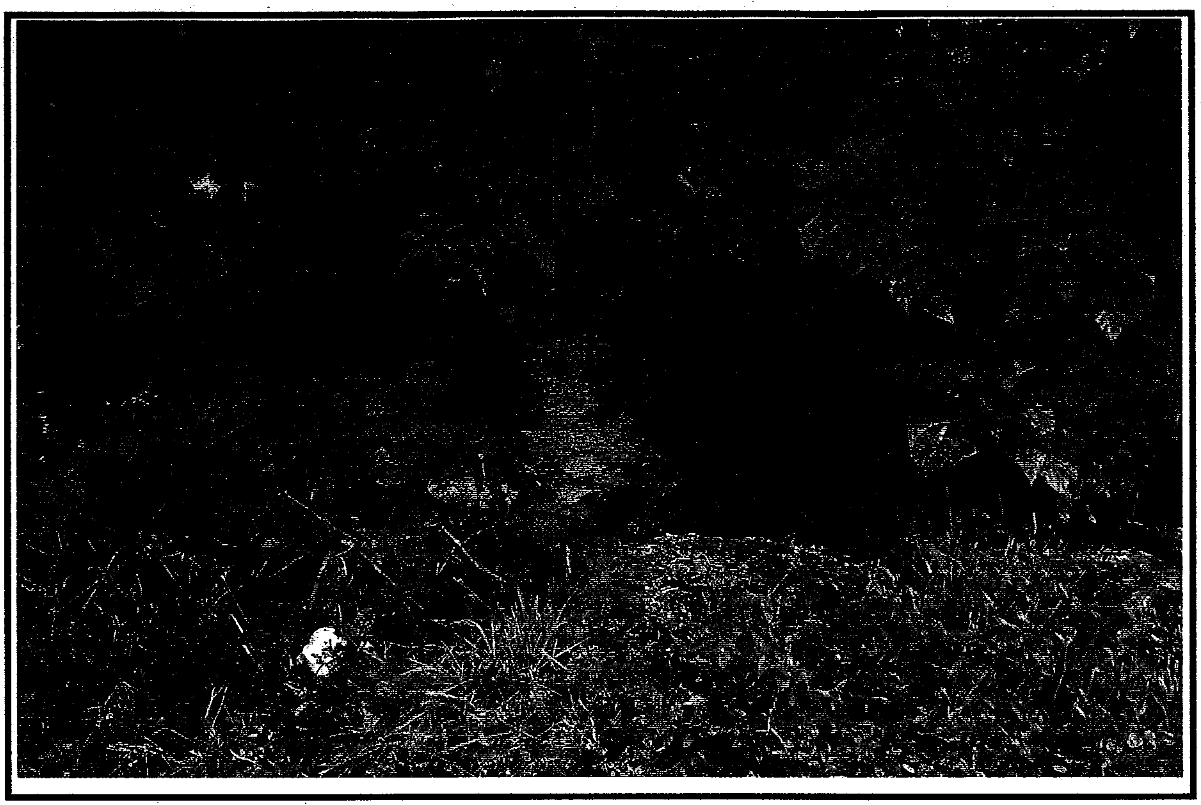


Photo E – Wetland #2 flows under Old Route 100 via pipe. This is a typical view of the wetlands near the road. There are no bog turtle habitats identified adjacent to the road in the areas of the proposed wetland crossing.

Photo F – A typical view of the upland areas adjacent to wetland #2 nearest to Old Route 100.

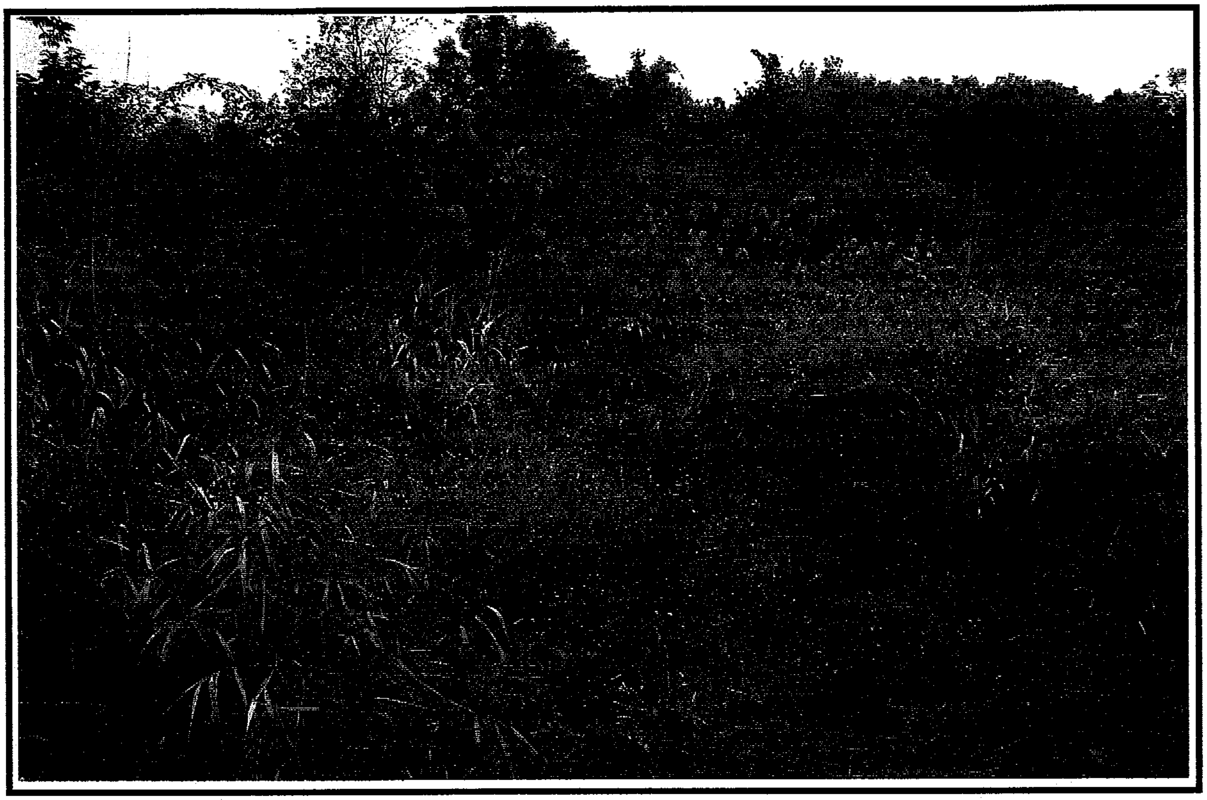


Photo G – Potential bog turtle habitat approximately 500 feet upstream of wetland #2. The proposed wetland crossing would be approximately 500 feet from this habitat and also across Old Route 100.

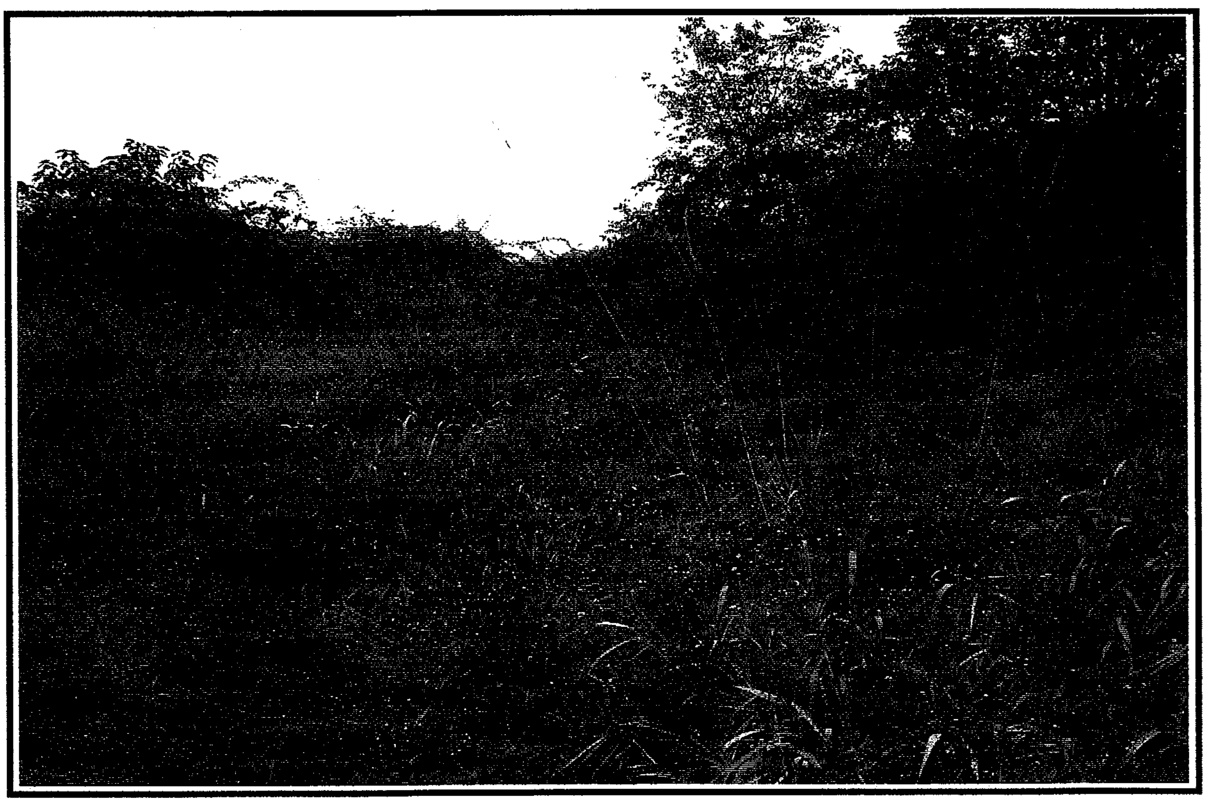


Photo H – The potential bog turtle habitat upstream of wetland #2 crossing is dominated by tearthumbs, rice-cut grass and reed-canary grass.

Photo I – Near wetland #3 crossing a freshwater spring flows from a pipe in the hillside is heavily impacted from foot traffic from local residents filling water jugs.

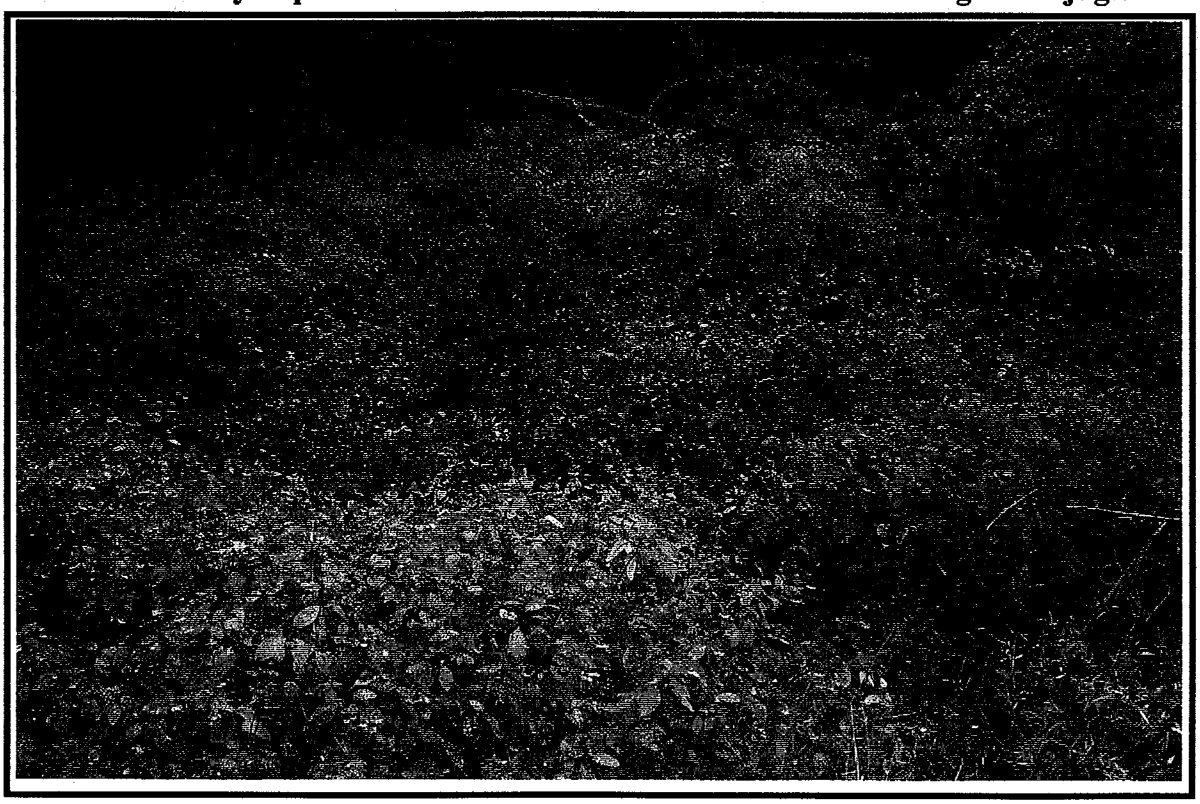


Photo J – An emergent area adjacent to the spring. This area is cut-off from other potential bog turtle habitats by Old Route 100 and was dominated by a closed canopy from surrounding mature trees. The wetland was piped under the road but was not thought to be a travel corridor for bog turtles.

Photo K – View, of mucky area in the vicinity of the spring area. The emergent area can be seen in the background.

Photo L – View of the wet area where the flow from the wetlands in Photos I, J and K is piped under Old Route 100.

Photo M – The proposed groundwater treatment system discharge pipeline route is planned to traverse the upland areas of the Old Route 100 right-of-way to avoid wetland impacts.

Photo N – View of the downstream face of the Old Route 100 Bridge over the Upper Perkiomen Creek. This is the area where the outfall is proposed to discharge to the

Photo O – View downstream, of the Upper Perkiomen Creek from the Old Route 100 Bridge. The area on the right side of the Creek is cleared for the powerline right-of-way. There are no wetlands in the cleared area.

Photo P – View upstream from the Old Route 100 Bridge. The Upper Perkiomen Creek is solid bottomed and exhibits moderately swift flow.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pennsylvania Field Office
315 South Allen Street, Suite 322
State College, Pennsylvania 16801-4850

December 2, 2004

[redacted]
Amy S. Greene Environmental Consultants
4 Walter E. Foran Blvd
Suite 209
Flemington, NJ 08822

Dear [redacted]

This responds to your letter of November 5, 2004, which provided the Fish and Wildlife Service with information regarding the Bally Groundwater Treatment System Discharge Pipeline in Bally Borough, Berks County, Pennsylvania. The proposed project is within the known range of the bog turtle (*Clemmys muhlenbergii*), a species that is federally listed as threatened. The following comments are provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to ensure the protection of endangered and threatened species.

The proposed project is to construct three stream/wetland crossings. Crossing #2 is adjacent to potential bog turtle habitat. Because of this, all work should be completed between November 1 and March 31, when bog turtles are brumating (hibernating). If work must be completed outside these dates, a qualified bog turtle surveyor should conduct a pre-construction bog turtle survey immediately prior to work activities, and a silt fence should be installed between the wetland and the crossing. If bog turtles are found during the survey, construction work must not be initiated, and the Service and Pennsylvania Fish and Boat Commission must be contacted.

This determination is valid for two years from the date of this letter. If the proposed project has not been fully implemented prior to this, an additional review by this office is recommended. Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

If this project is implemented with the above conditions, the Service concurs that construction is not likely to adversely affect any federally listed or proposed species or their habitat. This response relates only to endangered or threatened species under our jurisdiction, and this letter is not to be construed as addressing potential Service concerns under the Fish and Wildlife Coordination Act or other authorities.

Please contact Bonnie Dershem of my staff at 814-234-4090 if you have any questions or require further assistance regarding this matter.

Sincerely,

David Densmore
Supervisor

established 1866

Pennsylvania Fish & Boat Commission

Division of Environmental Services
Natural Diversity Section
450 Robinson Lane
Bellefonte, PA 16823-9620
(814) 359-5237 Fax: (814) 359-5175

November 16, 2004

IN REPLY REFER TO
SIR# 17411

Amy S. Greene Environmental Consultants
[redacted]
4 Walter E. Foran Boulevard, Suite 209
Flemington, NJ 08822

RE: **Species Impact Review (SIR) –Rare, Candidate, Threatened, and Endangered Species**
Bog Turtle Habitat Assessment
Bally Groundwater Treatment System Discharge Pipeline Route
Bally Borough, Berks County, Pennsylvania

Dear [redacted]

The staff of the Natural Diversity Section reviewed your recent correspondence regarding the above-referenced project. Based on records maintained in the Pennsylvania Natural Diversity Inventory (PNDI) database and our own files, the bog turtle (*Clemmys muhlenbergii*, state endangered, federal threatened) is known from the vicinity of the proposed project site.

You conducted a Phase 1 bog turtle habitat evaluation at the three wetland crossings and concluded that the habitat is not suitable for bog turtles in the immediate vicinity of the crossings. According to your report, the vegetation, hydrology, and soils are not consistent with wetlands known to support bog turtles. I concur with the conclusions of the Phase 1 habitat assessment; the habitat at the crossing locations is not suitable for bog turtles.

However, given the proximity of the site to known bog turtle occurrences and your identification of potential habitat upstream of Wetland #2, the stream and wetlands on-site could potentially be used by bog turtles as a travel corridor. In order to avoid disturbance to any bog turtles that may be occupying the site, I recommend that the crossing of Wetland #2 be conducted between November 1 and March 31 during the inactive period of the bog turtle. Best management practices and a strict approved erosion and sediment control plan should be maintained. If the work cannot be conducted before April 1, then arrangements for a pre-construction survey will be needed. All areas to be permanently or temporarily impacted, including staging areas, should be investigated/cleared by a qualified bog turtle surveyor before any work activities are to commence. Immediately following this clearance survey, silt fencing should be installed between the limit of disturbance and the remainder of the wetland in order to prevent turtles from entering the construction area. If any bog turtles are found during the clearance survey, the herpetologist is to move the turtle no further than necessary out of the immediate project area and is to contact this office.

If these recommendations can be implemented, best management practices are employed and strict erosion and sedimentation controls are used, then I do not foresee the proposed project resulting in adverse impacts to the bog turtle or any other rare or protected species under Pennsylvania Fish and Boat Commission jurisdiction.

Please contact Kathy Derge of my staff at (814) 359-5186 if you have any additional concerns regarding this response, and refer to the SIR number at the top of this letter. Thank you for your cooperation and attention to this matter of threatened and endangered species conservation.

Sincerely,

Christopher A. Urban, Chief
Natural Diversity Section

KLD/

cc: B. Dershem, USFWS
DEP-SC Region

PHASE II VISUAL SURVEY

for

BOG TURTLE
(*Glyptemys {Clemmys} muhlenbergii*)

Bally Water Supply
Washington Township, Berks County, Pennsylvania

July 12, 2005

SUBMITTED TO:
[redacted]
ARCADIS G&M, Inc.
6 Terry Drive, Suite 300
Newtown, PA 18940

FIELDWORK PERFORMED BY USFWS RECOGNIZED QUALIFIED BOG TURTLE SURVEYOR:

[redacted]

PREPARED BY:
AMY S. GREENE ENVIRONMENTAL CONSULTANTS INC.
4 Walter E. Foran Boulevard, Suite 209
Flemington, NJ 08822

ASGECI Project # 2526

TABLE OF CONTENTS

1.0. INTRODUCTION

1.1. Site Description

Amy S. Greene Environmental Consultants Inc. (ASGECI) was contracted to conduct a Phase II Visual Survey for bog turtle (*Glyptemys {Clemmys} muhlenbergii*) for ARCADIS, Inc., on a 43 acre rural parcel of land west of Route 100, between Wheeler Lane to the south and Longview Lane to the north (Section 3.0; Figure 2) in Washington Township, Berks County, Pennsylvania.

The site is currently utilized for agriculture. A field of last years stubs of corn and large fields of hay dominate the property. Freshwater seeps emerge from the hillside in a few places. The seeps feed emergent wetlands which contain pockets of muck interspersed with muddy heavier soil areas. Water flows underground beneath some of the areas with firm substrates. The site generally slopes from 560 feet on its western border to 475 feet above sea level at the wetlands on site's the eastern border (Section 3.0, Figure 3). Freshwater seeps from the elevated western portion of the property flow eastward and feed the wetlands on the eastern portion of the site (Section 3.0, Figure 2). Potential bog turtle habitat was identified in the emergent and scrub/shrub wetlands which receive the hydrology from the freshwater seeps.

Broad-leafed cattail, halberd-leaf tearthumb, spike rush, yellow-fruit sedge, reed canary grass and soft rush are the study area's dominant herbaceous wetland plants. Other herbaceous vegetation includes tussock sedge, skunk cabbage and horsetail (*Equisetum* sp.). Shrubs and woody vegetation dominating the stream corridor include red maple, willow species (*Salix spp*.), speckled alder, silky dogwood and multiflora rose (Appendix A, Photograph A). Emergent-scrub/shrub wetland complexes are the typical type of habitat for bog turtles when the right combination of vegetation, hydrology, and substrate are present.

1.2 Project Description

A municipal well for the Borough of Bally is proposed to be constructed on the property. The results of the Phase II survey will assist in placing the well in the proper location on the site. A pipeline to the Borough of Bally will be constructed from the well, and will run parallel and adjacent to Route 100.

1.3 Purpose of Study

The bog turtle northern population has been listed as threatened by the USFWS pursuant to Section 7 of the Endangered Species Act of 1973. USFWS guidance requires that habitat surveys for bog turtle be performed to determine if potentially suitable habitat occurs within proposed project limits in a region where bog turtle habitat is known to be present. If potentially suitable habitat is present within the limits of a project then the USFWS requires a visual bog turtle survey to be conducted (USFWS, May 2001).

Bog turtles are documented within Berks County and within the Perkiomen Creek drainage. Based on the Phase I Habitat Survey performed on the site, a Phase II Visual Survey for bog turtles would be required for the project.

1.4 Bog Turtle Range and Habitat

The bog turtle occurs discontinuously in western, central, and southern New York; western Connecticut and Massachusetts; New Jersey; northern Delaware and Maryland; southeastern and northwestern Pennsylvania; southwestern Virginia; and western North Carolina (Conant 1975). In Pennsylvania, bog turtle populations are currently documented in Adams, Berks, Bucks, Chester, Cumberland, Delaware, Franklin, Lancaster, Lebanon, Lehigh, Monroe, Montgomery, Northampton, and York counties.

Habitat for bog turtle includes sunlit marshy meadows, spring seeps, bogs, and fens, usually with shallow slow-moving water (Conant 1975; Behler and King 1997). Vegetation can include cattails (*Typha latifolia, T. angustifolia*), tussock sedge (*Carex stricta)*, other sedge species *(Carex spp.*, *Cyperus spp.*, *Dulichium sp.*), rushes (*Juncus spp.*), bulrushes (*Scirpus spp.*), spikerushes (*Eleocharis spp.*), jewelweed (*Impatiens spp.*), alders (*Alnus spp.*), skunk cabbage (*Symplocarpus foetidus*), arrow-leaved tearthumb (*Polygonum sagittatum*), rice cut-grass (*Leersia oryzoides*), and other open canopy wetland species (Cromartie, et al. 1982). Other elements listed in habitat descriptions include soft mucky substrates for basking and hibernation; an interspersal of wet and dry areas within sites, often with the presence of muskrat and meadow vole runways; a mosaic of habitats present such as uplands, shallow water and muck, and deeper water; and a largely open canopy, with scattered areas of shrubs and small trees (USFWS, 1997).

TABLE 1
SITE INFORMATION
Bally Water Supply
Rt. 100 and Wheeler Lane
Bally Borough, Berks County, PA

Approximate Size (Acres)	**Vegetative Characterization**	**Extent of Mucky Soils**	**Latitude/Longitude**	**Potential Species Habitat**	**Species Presence/ Probable Absence**
4.0	PEM – 80% PSS – 20%	80%	75. 34' 55.50" W 40. 24' 42.07" N	Yes	Probable Absence
SURVEY EFFORT PER WETLAND COMMUNITY:					
Palustrine Emergent (PEM) = 85% of hours Palustrine Scrub/Shrub (PSS) = 15% of hours					

2.0 PHASE II - VISUAL SURVEY

The areas deemed to have potential habitat for bog turtles during the Phase I Habitat Suitability Survey were investigated during the visual survey. The areas were selected in accordance with the USFWS "Bog Turtle (*Clemmys muhlenbergii*) Characteristics and Survey Guidelines" dated May 2000 (revised May 2001), pursuant to Section 7 of the Endangered Species Act of 1973. The survey methodology and results are provided below.

2.1 Methodology

Visual surveys were performed on May 5, May 12, May 19, and May 27, 2005. In a telephone conversation on May 4 2005, Bonnie Dershem of US Fish and Wildlife Service (USFWS) discussed the survey effort that would be required for the site with Scott Angus of ASGECI. Searches were based upon approximately 4 acres of emergent and scrub/shrub wetland in the study area. The surveys were led by Scott Angus a US Fish and Wildlife Service recognized qualified bog turtle surveyors, along with additional survey support provided by ASGECI staff scientists: Bill Smejkal, Harry Strano, Sue Quackenbush, Peter Scherr, and Max DeVane. Search groups were composed of three individuals. ASGECI utilized survey methodologies described in the U.S. Fish and Wildlife Service's "Bog Turtle (*Clemmys muhlenbergii*) Characteristics and Survey Guidelines" (May 2000, revised May 2001) for visual surveys.

The following represent the methodologies utilized by ASGECI staff while performing visual presence/absence bog turtle surveys:

1. ASGECI conducted four complete surveys between May 5 and May 27, 2005. USFWS guidelines require surveys between April 15 and June 15, the bog turtle's peak activity period during the year, as well as the time of year when vegetation is short and turtles may be more visible. Water, substrate, and air temperatures during the surveys were a minimum of 55 degrees F.

2. ASGECI conducted four surveys of the potential bog turtle habitat separated by three or more days as required by USFWS.

3. ASGECI surveyed the potential bog turtle habitat with three surveyors (at least one surveyor was a recognized qualified bog turtle surveyor).

4. The potential bog turtle habitat was surveyed for a minimum of four person-hours, within each acre of potential habitat and surroundings. Both random searching, opportunistic searching and transect surveys were used. Techniques such as probing, carefully moving vegetation (looking under tussock sedges), and sifting with hands through substrate, were also used.

5. Care was taken to walk quietly through the potential bog turtle habitat. Minimal disturbance to the habitat is necessary to increase the possibility of finding bog turtles basking on tussocks, mossy hummocks or in shallow water.

6. Field surveyors walked slowly and carefully through potential bog turtle habitat to avoid stepping on the tops of tussocks and hummocks where bog turtles might lay their eggs.

For each site visit the field surveyors recorded the date of the survey, time spent surveying, surveyors' names and qualifications, weather conditions (e.g. air and water/muck temperatures; percent cloud cover; wind, precipitation), presence or absence of turtles, and other reptile and amphibian species observed.

2.2 Results and Conclusions of Visual Survey

This survey was performed using the protocols for conducting Phase II bog turtle surveys as presented in the United States Fish and Wildlife Service Northern Population Recovery Plan (revised May 2001). **No bog turtles were observed during ASGECI Phase II visual surveys conducted on May 5, May 12, May 19, and May 27, 2005.** Other herptile species found during the surveys include American toad, green frog, pickerel frog and Eastern garter snake. A total number of 69 field/person hours were expended during the four survey dates. The wetland areas deemed potentially suitable in the Phase I survey were intensively searched visually and by probing in mucky areas, particularly in the very wet and mucky micro-sites scattered throughout the suitable habitat area. Areas adjacent to the potential habitat were also searched for foraging or roaming turtles. The daily field results are summarized below.

PHASE II VISUAL SURVEY

for

BOG TURTLE
(*Glyptemys {Clemmys} muhlenbergii*)

Bally Water Supply
Washington Township, Berks County, Pennsylvania

July 12, 2005

SUBMITTED TO:
[redacted]
ARCADIS G&M, Inc.
6 Terry Drive, Suite 300
Newtown, PA 18940

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[redacted]

PREPARED BY:
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4 Walter E. Foran Boulevard, Suite 209
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ASGECI Project # 2526

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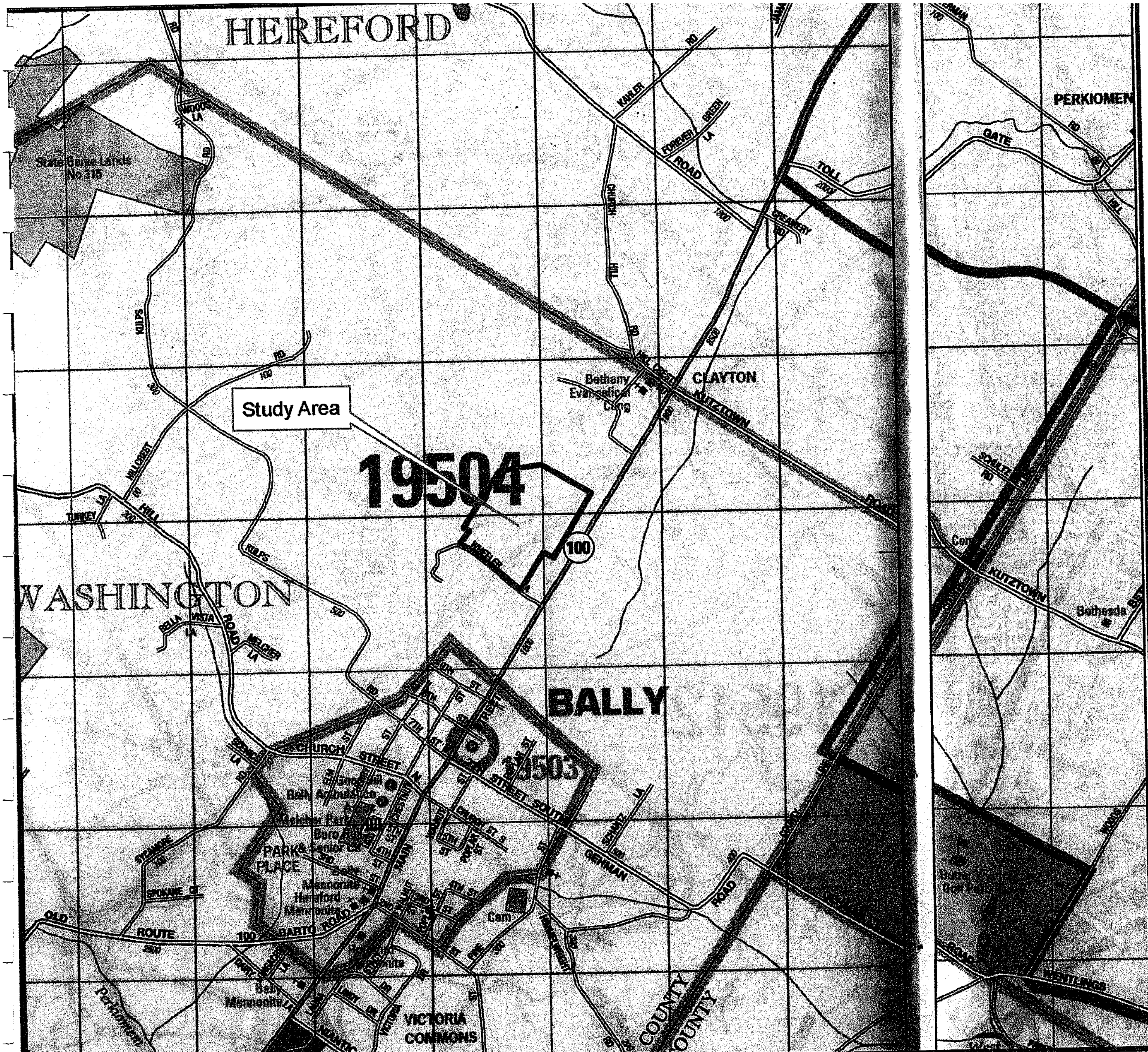
TABLE 2
BALLY WATER SUPPLY
WASHINGTON TOWNSHIP
BERKS COUNTY, PENNSYLVANIA
PHASE II SURVEY DETAILS
(TOTAL ESTIMATED SURVEY AREA: 4.0 ACRES)

Date of Survey	Surveyors	Survey Conditions	Survey Effort	Herptiles Encountered
5/5/05	S. Angus* H. Strano S. Quackenbush	**Start:** Ambient Temperature: 62°F Avg. Wind Speed: 1.1 mph Soil/Water Temperature: 58°F Cloud Cover: 10% Rel. humidity: 42% **Finish:** Ambient Temperature: 70.8 °F Avg. Wind Speed: 1.6 mph Soil/Water Temperature: 58°F Cloud Cover: 30% wispy Rel. humidity: 24%	9:00 - 15:00 (18 man-hours)	Green Frog American Toad
5/12/05	S. Angus* P. Scherr M. DeVane	**Start:** Ambient Temperature: 70.2°F Avg. Wind Speed: 3.6 mph Soil/Water Temperature: 68°F Cloud Cover: 40% Rel. humidity: 32% **Finish:** Ambient Temperature: 73°F Avg. Wind Speed: 1 mph Soil/Water Temperature: 72°F Cloud Cover: 10% Rel. humidity: 27%	9:00 - 15:00 (18 man-hours)	Green Frog American Toad

Date of Survey	Surveyors	Survey Conditions	Survey Effort	Herptiles Encountered
5/19/05	S. Angus* B. Smejkal* H. Strano	**Start:** Ambient Temperature: 63°F Avg. Wind Speed: 0.7 mph Soil/Water Temperature: 58°F Cloud Cover: 10% Rel. humidity: 40% **Finish:** Ambient Temperature: 75°F Avg. Wind Speed: 1 mph Soil/Water Temperature: 59°F Rel. humidity: 50% Cloud Cover: 40%	09:00 – 14:30 (16.5 man-hours)	Green Frog American Toad E. Garter Snake
05/27/05	S.Angus* B. Smejkal* H.Strano	**Start:** Ambient Temperature: 78°F Avg. Wind Speed: 0.6 mph Soil/Water Temperature: 66.4°F Cloud Cover: 5% Rel. humidity: 54% **Finish:** Ambient Temperature: 91.4°F Avg. Wind Speed: 0.7 mph Soil/Water Temperature: 68.3°F Cloud Cover: 30% Rel. humidity: 53%	10:00 - 15:30 (16.5 man-hours)	American Toad Green Frog Pickerel Frog
* Indicates the name of a USFWS recognized bog turtle surveyor.				

3.0 FIGURES



0 1,050 2,100 Feet

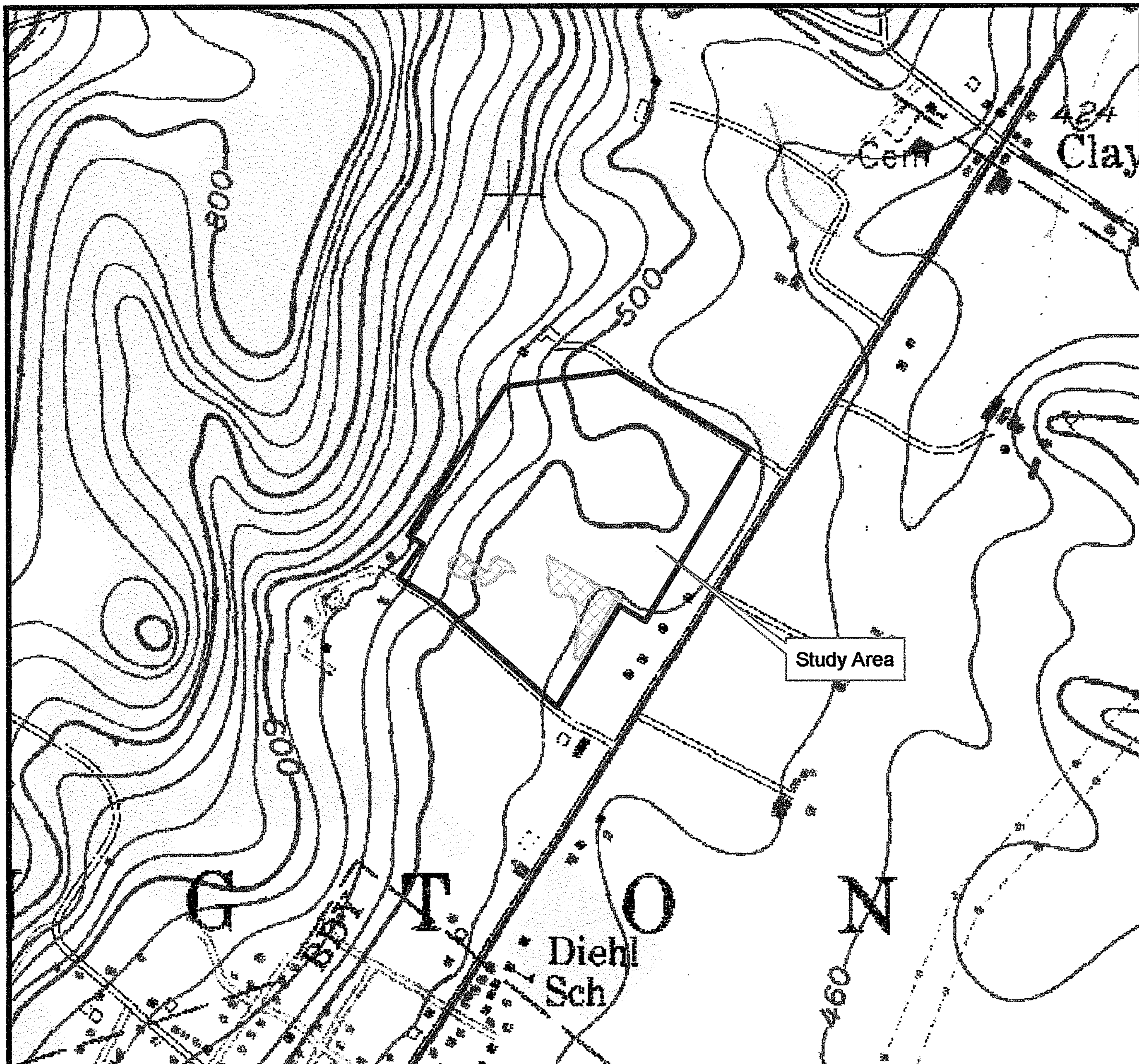
SOURCE: Berks County, Pennsylvania, The Original Street Map Book, Alexandria Drafting Company, Alexandria, VA, 2003.

FIGURE 1
COUNTY ROAD MAP

Bally Water Supply
Bally Borough
Berks County, Pennsylvania

ASGECI Project #2526

AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS INC



Legend

Study Area

Potential Bog Turtle Habitat

0 385 770 Feet

SOURCE: 7.5 minute Digital Raster Graphic for East Greenville, PA Quadrangle (o40075d5), USGS, Reston, VA, 1996.

FIGURE 2
USGS TOPOGRAPHIC MAP OF POTENTIAL BOG TURTLE HABITAT

Bally Water Supply
Bally Borough
Berks County, Pennsylvania

ASGECI Project #2526

AMY S. GREENE
ENVIRONMENTAL
CONSULTANTS INC

Legend

Study Area

Potential Bog Turtle Habitat

0 200 400 Feet

SOURCE: Aerial photography obtained from Digital Orthophoto (DOQQ) MrSID mosaic for East Greenville Quadrangle (NAPP III, 1997-2001), USGS, Pennsylvania Bureau of Topographic and Geologic Survey, Reston, VA, 2000.

FIGURE 3
AERIAL PHOTOGRAPH OF POTENTIAL BOG TURTLE HABITAT

Bally Water Supply
Bally Borough
Berks County, Pennsylvania

ASGECI Project #2526

AMY S. GREENE
ENVIRONMENTAL
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4.0 LIST OF REFERENCES

Arndt, R.G. 1977. Notes on the Natural History of the Bog Turtle, (*Clemmys muhlenbergii)*, in Delaware. Chesapeake Science 18(1):67-76.

Behler, John L. and Wayne King. 1979. The Audubon Society Field Guide to North American Reptiles and Amphibians. Alfred A. Knopf, New York. 791 pp.

Conant, R. 1975. A Field Guide of Reptiles and Amphibians of Eastern and Central North America, second edition. Houghton Mifflin Company, Boston.

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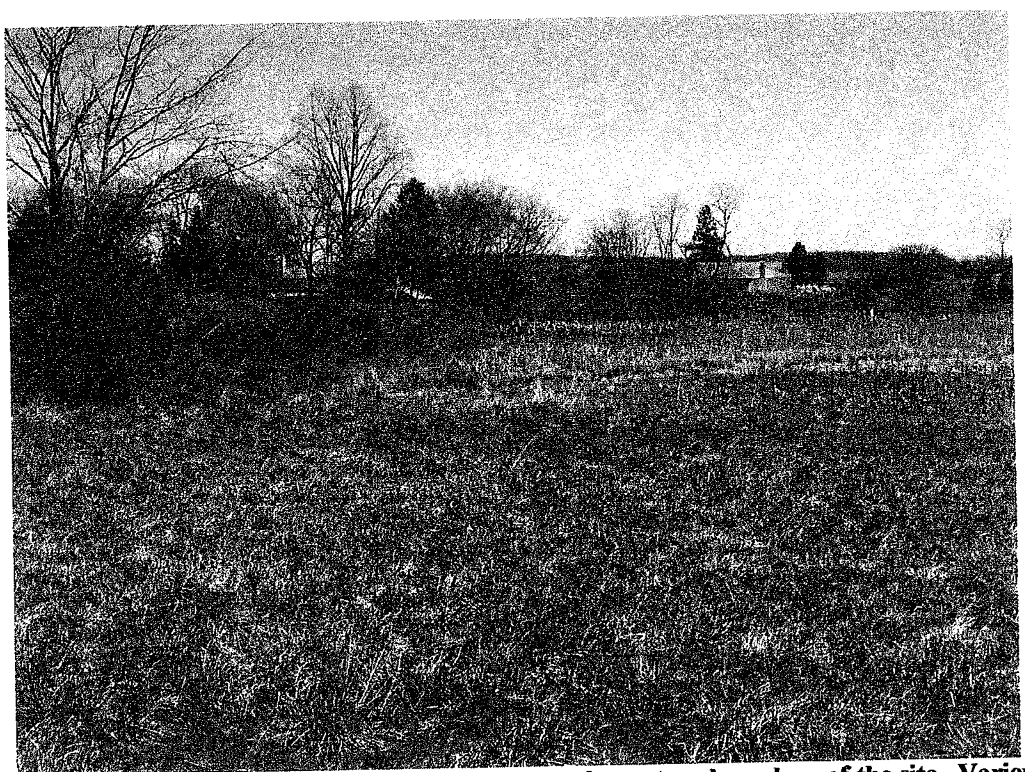
U.S. Fish and Wildlife Service. May 2001. Bog Turtle (*Clemmys muhlenbergii*) Northern Population Recovery Plan.

APPENDIX A

PHOTOGRAPHS

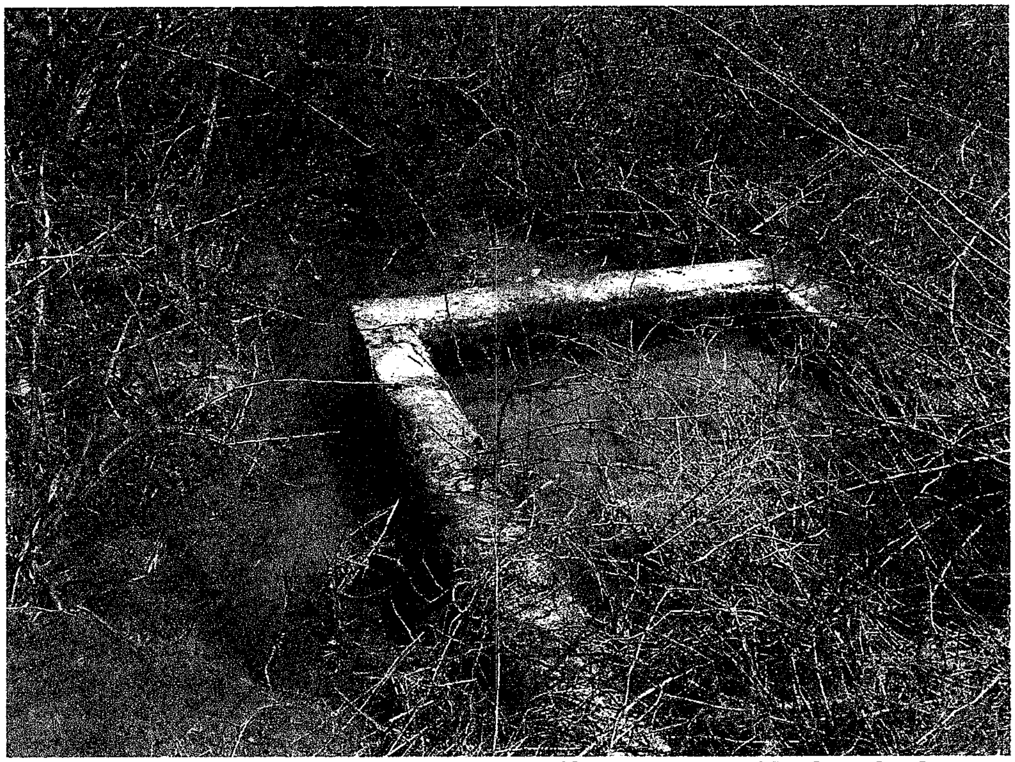
Photograph A: View of the emergent cattail and scrub/shrub wetlands in the eastern portion of the survey area. Note the ditch in right corner of the photo.



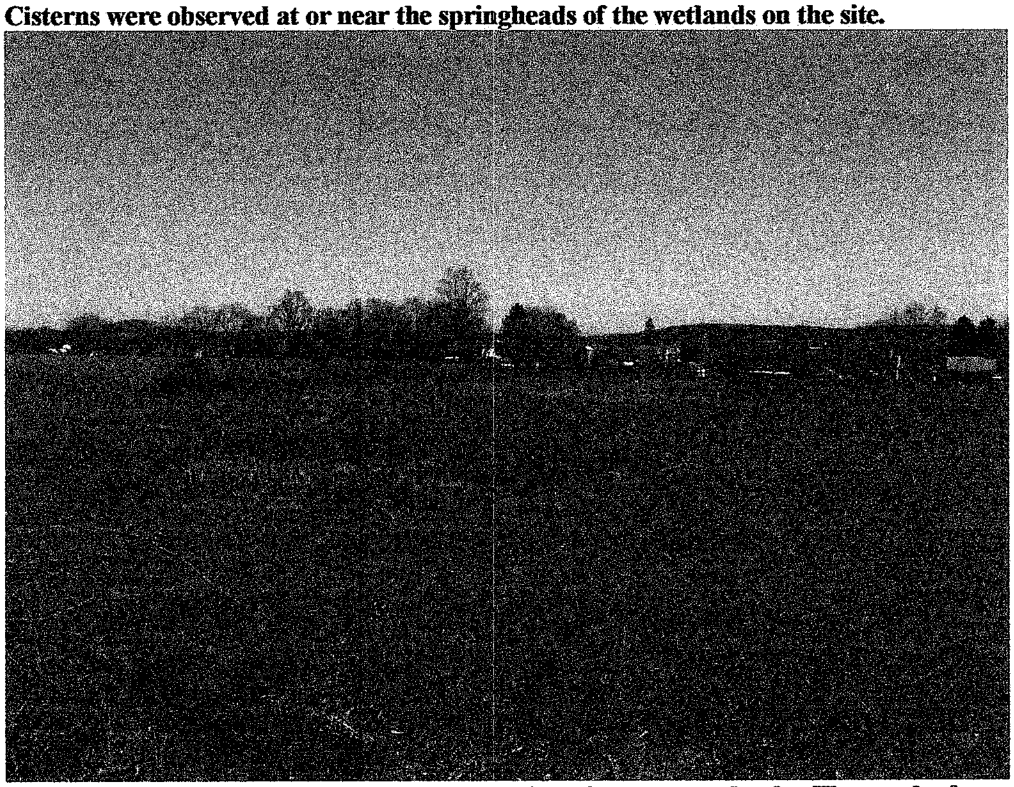
Photograph B: View of the wetlands adjacent to the eastern boundary of the site. Various sedges dominate wetlands in the foreground. Firm soils transition to muckier soils as you approach the shrubs and cattails, visible in the photo.

Photograph C: An animal trail within the cattail portion of the wetland. Microhabitats with mucky soils and slow flowing water such as this are typical in most of the study area.

Photograph D: View of eastern portion of wetland showing a rivulet within the emergent wetland. This portion of the wetland is dominated by sedges and rushes, and the scrub/shrub wetlands.



Photograph E: View of a cistern within the multiflora rose, scrub/shrub wetland area. Cisterns were observed at or near the springheads of the wetlands on the site.



Photograph F: View looking northeast toward project area wetlands. The patch of emergent wetland in the foreground contains areas of suitable soils, vegetation and ground water hydrology. This portion of the wetlands were thoroughly searched during each survey. Note: The area is dominated by soft rush and broad-leaf cattail and tussock sedge.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Pennsylvania Field Office
315 South Allen Street, Suite 322
State College, Pennsylvania 16801-4850

September 8, 2005

RECEIVED
SEP 12 2005
AMY S. GREENE
ENVIRONMENTAL CONSULTANTS INC.

[redacted]
Amy S. Greene Environmental Consultants, Inc.
4 Walter E. Foran Boulevard, Suite 209
Flemington, NJ 08822

RE: USFWS Project #2005-2356

Dear [redacted]

This responds to your letter of July 12, 2005, which provided the Fish and Wildlife Service with information regarding the proposed Borough of Bally municipal well, located in Washington Township, Berks County, Pennsylvania. The proposed project is within the range of the bog turtle (*Clemmys muhlenbergii*), a species that is federally listed as threatened. The following comments are provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) to ensure the protection of endangered and threatened species.

You have provided a copy of your July 12, 2005, *Phase 2 Survey Report*. According to this report, which describes the survey conducted by you on May 5, 12, 19, and 27, 2005, no bog turtles were found in project area wetlands. Therefore, based on our review of this information, we conclude that construction of this project will not affect the bog turtle.

If this project is implemented as proposed, construction will not affect any federally listed or proposed species or their habitat. This response relates only to endangered or threatened species under our jurisdiction. Consequently, this letter is not to be construed as addressing potential Service concerns under the Fish and Wildlife Coordination Act or other authorities.

To avoid potential delays in reviewing your project, please use the above-referenced USFWS project tracking number in any future correspondence regarding this project.

If you have any further questions regarding this matter, please contact Jennifer Dombroskie of my staff at 814-234-4090.

Sincerely,

David Densmore
Supervisor

PENNSYLVANIA FISH & BOAT COMMISSION
established 1866

Pennsylvania Fish & Boat Commission

Division of Environmental Services
Natural Diversity Section
450 Robinson Lane
Bellefonte, PA 16823-9620
(814) 359-5237 Fax: (814) 359-5175

August 23, 2005

AUG 2 5 2005

IN REPLY REFER TO
SIR# 20252

AMY S. GREENE ENVIRONMENTAL CONSULTANTS
[redacted]
4 WALTER E. FORAN BLVD., SUITE 209
FLEMINGTON, NJ 08822

RE: Secondary Species Impact Review (SIR) #20252
Bog Turtle Survey
BALLY WATER SUPPLY
WASHINGTON Township, BERKS County, Pennsylvania

Dear [redacted]

The staff of the Natural Diversity Section reviewed your recent correspondence regarding the above-referenced project and its potential to adversely impact the bog turtle (*Clemmys muhlenbergii)*, Pennsylvania endangered, federally listed as threatened.

As an approved bog turtle surveyor following the U.S. Fish and Wildlife Service Guidelines, you conducted a Phase 2 presence/absence survey for bog turtles, during the appropriate seasonal and climatic conditions in 2005. No bog turtles were found during the surveys. We concur with your conclusion – presently, bog turtles do not exist at these wetlands.

Provided that best management practices are employed and strict erosion and sedimentation controls are used, I do not foresee the proposed project resulting in adverse impacts to the bog turtle or any other rare or protected species under Pennsylvania Fish and Boat Commission jurisdiction. Thank you for your cooperation and attention to this matter of threatened and endangered species conservation.

Sincerely,

Christopher A. Urban, Chief
Natural Diversity Section

RTM/ma

cc: B. Dershem, USFWS
DEP-SC Region